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"THE ENGINEER," SEPTEMBER 24, 1926

With METALLURGICAL SUPPLEMENT.

The Engineer.

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VOL. CXLII.—No. 3689] LONDON: FRIDAY EVENING, SEPTEMBER 24, 1926 [PRICE { WITH SUPPLEMENT } ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—

1. About 240 TONS GALVANISED CORRUGATED MILD STEEL SHEETS and RIDGING.
2. 1000 STEEL TYRES for CARRIAGES and WAGONS.
3. 530 PAIRS DISC WHEELS and AXLES and 500 DISC WHEEL CENTRES.
4. 1600 STEEL AXLES for CARRIAGES and WAGONS.
5. About 145 TONS MILD STEEL SHEETS.
6. About 620 TONS MILD STEEL SECTIONS, Weldable Quality.
7. About 159 TONS of SPRING STEEL.
8. MACHINERY for SINGLE-SCREW TUG, including INVERTED TWO-CYLINDER COMPOUND SURFACE CONDENSING TYPE ENGINE, 300 I.H.P., BOILER, &c.
9. FITTINGS for 4 RAILWAY TOURIST CARS.
10. TWO 10-TON STEAM TRAVELLING CRANES for 5ft. 6in. Gauge.
11. 12 BOGIE TRUCKS and SPARE PARTS for METRE-GAUGE RAILWAY CARRIAGES.
12. TWO 14 TONS BRIDGE ERECTING CRANES.

Tenders due on the 8th October, 1926, for No. 1, on 12th October, 1926, for Nos. 2 to 8, and on the 19th October, 1926, for Nos. 9 to 12.

Specifications and forms of Tender obtainable from the above at a fee of 5s. per set, which will not be returned. 3606

Assistant Engineers (4) REQUIRED for the PUBLIC WORKS DEPARTMENT of the FEDERATED MALAY STATES for four years' service, after which, subject to satisfactory service, the officers appointed will be eligible for confirmation in the permanent and pensionable establishment. Salary 400 dollars a month, rising to 800 dollars by annual increments of 25 dollars, plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but its purchasing power in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. No income tax at present imposed by the Federated Malay States Government. Free passages provided. Candidates, age 23 to 26, preferably unmarried, must have received a good theoretical training, preferably at a University or College recognised by the Institution of Civil Engineers, and possess a Civil Engineering Degree or obtained such other diplomas or distinction in engineering as the Secretary of State may decide in any particular case or have completed articles with a civil engineer of good standing, and have passed the examination for Associate Membership of the Institution of Civil Engineers. In addition, candidates must have had at least one year's practical experience of civil engineering under a qualified civil engineer.—Apply at once by letter, giving brief details of qualifications and experience and stating age and whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting clearly at the head of application M/14378. 3608

Assistant Engineers (10) REQUIRED by the GOVERNMENT of NIGERIA for the PUBLIC WORKS DEPARTMENT for two tours of not less than 12 nor more than 18 months' service in the first instance. Subject to satisfactory service, the officers appointed will be eligible at the expiration of three years' service for confirmation in the permanent and pensionable establishment. Salary £480, rising to £920 a year. Outfit allowance of £50 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, preferably between 25 and 30 years of age, unmarried, must have passed the examination for A.M.I.C.E. or possess a degree in civil engineering recognised by the Institution as exempting from Parts "A" and "B" of the examination. They must have had proper technical training and preferably have had not less than two years' subsequent experience on large engineering or municipal works. Candidates possessing other civil engineering qualifications may apply.—Applications should be made at once by letter, stating age, qualifications and experience, also whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W. 1, quoting M/14485. 3528

Indian State Railways. ASSISTANT ELECTRICAL ENGINEER.

The Secretary of State for India is prepared to receive APPLICATIONS (by letter only) for APPOINTMENT as ASSISTANT ELECTRICAL ENGINEER from properly qualified candidates. Age should not exceed 35 years.

QUALIFICATIONS.—Applicants must have served an apprenticeship and have been employed in responsible positions with a firm of electrical or mechanical engineers, or with an electrical power company, and have obtained a good electrical degree at some recognised College. They must be capable of designing, estimating for and supervising the construction of lighting and power projects, and also possess a good working knowledge of oil engines. Considerable experience of steam turbines and high-tension distribution is also required.

SALARY.—Commencing at Rupees 375 to Rs. 625 (plus overseas pay if of non-Asiatic domicile), according to age and qualifications, also Provident Fund and gratuity benefits. Pay commences from date of landing in India to take up appointment. Promotion, increases, travelling allowances while on duty, &c., according to the rules in force.

TERMS.—A three years' agreement, subject to satisfactory service, and first-class free passage to India. Strict medical examination before appointment.

Applications, giving full details of career, age, whether married (also family, if any) or single, and names of firms, &c., by whom employed from time to time, class of work engaged upon, and position occupied in each case, together with dates of entering and leaving such service, should be addressed to the undersigned not later than 30th October, 1926.

RENDEL, PALMER & TRITTON,
12-14, Dartmouth-street,
Westminster, S.W. 1. 3590

Wanted Temporarily, TWO fully experienced DRAUGHTSMEN, capable of designing gun mountings and carriages. A knowledge of endless-track vehicle and heavy motor chassis design would be an advantage.

Apply, stating age, experience, salary required, and when at liberty, to the SUPERINTENDENT OF DESIGN, Royal Arsenal, Woolwich, S.E. 18. 3602

The Engineer

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PUBLIC NOTICES

Assistant Engineers (3) REQUIRED for the IRRIGATION SERVICE of IRAQ for two years' service on probation in the first instance, with prospects of extension for 10 years. Free passages and liberal leave on full salary. Salary Rs. 650, rising to Rs. 800 a month by annual increments of Rs. 50. Candidates, preferably between 23-26 years of age, unmarried, should have passed the A.M.I.C.E. examination, have been educated at one of the leading Universities and have one or two years' practical experience since obtaining degrees.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W. 1, quoting M/14691. 3609

Required for the East Indian Railway (Calcutta Chord Railway Project) :—

(A) TWO TEMPORARY ENGINEERS. Should possess a recognised degree in Civil Engineering or its equivalent, and have had not less than 10 years' practical experience on works of some magnitude. Preference given to candidates who have actually been employed on construction of a large bridge with deep foundations. Age must not exceed 45 years. Pay at a fixed rate between Rs. 1200 and Rs. 1800 per calendar month, according to qualifications.

(B) TWO BRIDGE FOREMEN. Must have been trained as Bridge Erectors with either a British Railway Company or Contractor in Bridge Building, and have had actual experience and preferably charge of erection at site of large steel bridges. Age not more than about 35 years. Pay at a fixed rate between Rs. 600 and Rs. 800 per calendar month, according to qualifications.

(C) ONE ELECTRICAL FOREMAN. Must have served a regular apprenticeship with an Electrical Firm of repute and have had some considerable experience of high and low-tension working. Preference given to a candidate who has had actual charge of electrical work on a large engineering project. Age not more than about 35 years. Pay at a fixed rate between Rs. 600 and Rs. 800 per calendar month, according to qualifications.

Forms of application and further particulars should be obtained from the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications 2nd October, 1926. 3607

PUBLIC NOTICES

Fully Trained Electrical DRAUGHTSMEN REQUIRED, having good technical training and experience in design and lay-out of lighting and power (including heating and cooking) circuits, polyphase alternating current; special initiative necessary in modifying standard electrical fittings and equipment to suit airship requirements. Applicants having no previous aircraft experience must be prepared as a condition of appointment to spend a preliminary training period not exceeding three months at the Royal Aircraft Establishment, Farnborough. No special allowance will be payable above ordinary salary during this period.

Salary £160 plus Civil Service bonus, giving a total of £246 per annum.

Preference will be given to ex-Service applicants.

Applications, giving full particulars, should be forwarded to the DIRECTOR OF AIRSHIP DEVELOPMENT, Royal Airship Works, Cardington, Bedford, on or before the 20th October, 1926. 3589

The Institution of Structural ENGINEERS.

The first MEMBERSHIP COMMITTEE MEETING of the new Session will be held on OCTOBER 6th, and intending candidates should forward their applications before 4th October. Syllabus and full particulars from the undersigned.

MAURICE G. KIDDY,
Secretary of the Institution.
10, Upper Belgrave-street, S.W. 1. 3559

Manchester Corporation. DAVYHULME SEWAGE WORKS, PENSTOCKS.

The Rivers Committee invite TENDERS for the SUPPLY and ERECTION of PENSTOCKS at the Davyhulme Sewage Works. Plans may be seen and specification, bill of quantities and form of Tender obtained on application at the City Engineer's Office, Town Hall, Manchester, on payment to the City Treasurer of Two Guineas (£2 2s.), which sum will, after the Corporation have come to a decision upon the Tenders received, but not before, be returned to the persons submitting a bona fide Tender.

All cheques or postal orders are to be made payable to the order of "The Corporation of Manchester."

Tenders, enclosed in the official envelope and addressed to the Chairman of the Rivers Committee, are to be delivered at the City Engineer's office not later than 9.30 a.m. on Friday, October 15th, 1926.

The Corporation do not bind themselves to accept the lowest or any Tender.

P. M. HEATH,
Town Clerk.
Town Hall, Manchester,
20th September, 1926. 3582

PUBLIC NOTICES

Armstrong College, NEWCASTLE-UPON-TYNE.
(IN THE UNIVERSITY OF DURHAM.)

COURSES for the PASS DEGREE of B.SC. and the HONOURS DEGREE of B.SC. in MECHANICAL, MARINE, CIVIL or ELECTRICAL ENGINEERING, MINING, METALLURGY, or NAVAL ARCHITECTURE. The curricula of the Pass Degree and the Honours Degree normally occupy periods of three and four years respectively, but candidates presenting evidence of sufficient previous training may be allowed to proceed to either Degree after two years' residence.

The engineering laboratories have recently been extended, and all Departments are equipped for advanced tutorial and research work.

The NEXT SESSION COMMENCES on 5th OCTOBER, 1926.

Full particulars of the Courses may be had on application to

THE REGISTRAR,
Armstrong College,
2512 Newcastle-upon-Tyne.

Public Works, Roads and Trans- PORT CONGRESS AND EXHIBITION.
NOVEMBER, 1927.
PAPERS.
COMPETITION FOR THE AWARD OF PRIZES.

The Congress Organising Committee have decided to offer the following Prizes for Papers which are submitted for discussion at the Congress to be held in November, 1927 :—

1ST PRIZE—GOLD MEDAL AND £50.
2ND PRIZE—SILVER MEDAL AND £25.
3RD PRIZE—BRONZE MEDAL AND £10.

The competition is open without restriction of nationality.

The subject of each Paper must be one which falls within the services covered by the Congress, that is to say :—Highways and Bridges, Water Supply, Sewerage and Sewage Disposal, Cleansing, Gas, Electricity, Housing and Town Planning, Tramways and Light Railways, Agriculture (Small Holdings, Land Drainage, Land Reclamation and Agricultural Education), and Local Government Organisation.

Papers must be submitted not later than the 17th January, 1927.

Application for the rules of the competition must be made to the HON. SECRETARY, Public Works, Roads and Transport Congress, 84, Eccleston-square, London, S.W. 1, from whom more detailed information as regards the subjects for Papers may also be obtained.

Papers may be submitted for discussion at the Congress without being entered for competition. Such papers should be clearly marked "Not for competition." 3008

Borough of Bexhill. MAIN DRAINAGE.
CONTRACT NO. 1.
TO CONTRACTORS.

The Corporation of Bexhill are prepared to receive TENDERS for the CONSTRUCTION of 24in. and 30in. CONCRETE TUBE SEWERS; 6ft. by 3ft. 4in. and 5ft. by 3ft. 4in. EGG-SHAPED SEWERS; an additional STORAGE TANK; and a 48in. CAST IRON SEA OUTFALL, all in accordance with the plans and specification prepared by the Engineer, Mr. G. Midgley Taylor, of Messrs. John Taylor and Sons, Caxton House, Westminster, S.W. 1.

Contractors desirous of tendering may obtain copies of the general conditions, specification, bill of quantities, and form of Tender and may inspect the drawings at the office of the Engineer upon payment of £5 (cheque only), which will be returned on the receipt of a bona fide Tender.

Tenders, endorsed "Main Drainage, Contract No. 1," must be delivered in a sealed package, addressed to the Town Clerk, Town Hall, Bexhill-on-Sea, before Twelve Noon on Saturday, the 16th day of October, 1926.

The Corporation do not bind themselves to accept the lowest or any Tender.

S. J. TAYLOR,
Town Clerk.
Town Clerk's Office,
Town Hall, Bexhill,
22nd September, 1926. 3599

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PUBLIC NOTICES

City of Liverpool.

CITY ENGINEER'S DEPARTMENT.
OFFER FOR SALE OF STEAM HOPPER BARGE.

The Corporation are prepared to receive TENDERS for the SALE of the STEAM HOPPER BARGE "BETA," as she lies in the Stanley Dock, Liverpool. This vessel was utilised for dumping city refuse at sea, but a larger vessel has now been obtained.

Chief particulars of the vessel :—

Length B.P.	151 feet
Breadth moulded	25 feet
Depth moulded	25 feet
Mean loaded draft	11 feet
Gross tonnage	394
Net registered tonnage	225
Nominal H.P.	75

5 hopper compartments, each fitted with four bottom doors.
Electric light.

Forms of Tender, general particulars, and conditions of sale may be obtained from :—
The City Engineer, Municipal Buildings, Dale-street, Liverpool ;
or from the Corporation Agents,
Messrs. C. W. Kellock and Co., Ltd., Cunard Building, Water-street, Liverpool ;
and Tenders, endorsed "Tender for the S.H.B. 'Beta,'" should be sent through the post, addressed to the
Town Clerk,
Municipal Buildings, Dale-street, Liverpool,
so as to be received not later than Ten o'clock a.m. on Tuesday, the 5th October, 1926.
The Corporation do not bind themselves to accept the highest or any Tender or to defray any expenses incurred in connection with the submission of Tenders
WALTER MOON,
3575 Town Clerk.

South Indian Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of :—
1. FIVE BOGIE WATER TANK WAGONS.
2. STEEL WORK FOR BRIDGES.
Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.
Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Bogie Water Tank Wagons," or as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, the 15th October, 1926.
The Directors do not bind themselves to accept the lowest or any Tender.
A charge, which will not be returned, will be made of :—
10s. for each copy of Specification No. 1 ; and
5s. for each copy of Specification No. 2.
Copies of the drawings may be obtained at the offices of Messrs. Robert White and Partners, Consulting Engineers to the Company, 3, Victoria-street, S.W. 1.
A. MUIRHEAD,
Managing Director.
91, Petty France, S.W. 1.
21st September, 1926. 3605

The Madras and Southern MAHRATTA RAILWAY COMPANY, Limited,

25, Buckingham Palace-road, Westminster, S.W. 1 invite TENDERS for :—

(1) { 2—50 Feet / 4—40 Feet / 1—10 Feet / 4— 6 Feet } CLEAR DECK SPANS (approx. weight 95 tons).
{ 2—30 Feet } (SKEW) HALF THROUGH SPANS (approx. weight 125 tons).
(2) STEEL MATERIAL (FLATS, ROUNDS, CHANNELS, BARS, &c.) (approx. weight 1540 tons).
(3) GALVANISED STEEL or IRONWORK (approx. weight 71 tons).
(4) GALVANISED STRAND WIRE (approx. weight 42 tons 17½ cwt.), and 14,460 STEEL PALES for FENCING.
(5) 4310 Lineal Feet CAST IRON PIPING.
(6) 7000 Lineal Yards SAIL CANVAS.

Tenders are due in for (1) on Tuesday, 19th October, 1926, by 10.30 a.m.; for (2) to (6) on Tuesday, 19th October, 1926, by 2 p.m.
Tender forms obtainable at above address : fee One Guinea each, which is not returnable.
The Directors do not bind themselves to accept the lowest or any Tender. 3601

Bombay, Baroda and Central INDIA RAILWAY.

ASSISTANT ELECTRICAL ENGINEER.

REQUIRED for service with the above Railway in India, an ASSISTANT ELECTRICAL ENGINEER, who must have had a good general and technical education and a thorough training in Electrical Engineering Workshops. Experience in Electric Traction is an advantage. Candidates should not be over 30 years of age.
SALARY.—Commencing at Rupees 600 per calendar month, with increases according to the rules in force.
TERMS.—A three years' agreement in the first instance, first-class free passage to India and home again on satisfactory termination of services. The selected candidate will be required to pass a strict medical examination by the Company's Consulting Physician before appointment.
Applications (by letter only) should be addressed to the undersigned not later than 2nd October, 1926, and should give full particulars of candidate's education, training and experience, in chronological order (with dates). Applicants should also state their age and whether they are married or single.
S. G. S. YOUNG,
Secretary.
Offices : The White Mansion,
91, Petty France, Westminster, S.W. 1.
17th September, 1926. 3581

Sudan Government Irrigation Department,

REQUIRE the SERVICES of a number of ENGINEERS for Construction Work. Age 23 to 35, preferably unmarried. Salary offered from £E480 to £E720 per annum, according to age and qualifications (£E1 equals £1 0s. 6d. approximately) Applicants should be qualified civil engineers with practical experience in construction work. Knowledge of French and/or Arabic would be an advantage. Strict medical examination. Free first-class passage.—Applications, with full particulars, should be addressed to the ADVISORY ENGINEER, Sudan Government London Office, Wellington House, Buckingham-gate, S.W. 1, marking envelope "Asst. Engineers." 3585

"JOURNAL OF SCIENTIFIC INSTRUMENTS."
The EDITOR WELCOMES ORIGINAL ARTICLES on Workshop Practice (Processes, Tools, Methods of Machining Accurate Parts, &c.) which may be of interest to users and manufacturers of scientific instruments.
Communications should be addressed to the Editor, Dr. C. V. DRYSDALE, 11, Barkston-gardens, London, S.W. 5. 3614

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED.

ELECTRICAL ENGINEER by Continental Firm ; only experienced salesman, good connection to textile industry in Lancashire or Yorkshire, need apply. State salary and particulars.—Write to R. L. 817, c/o Ala, Haasenstein and Vogler, Cologne-on-Rhine. P2272 A

ASSISTANT MECHANICAL ENGINEER (Young) REQUIRED by London Firm. College graduate, some practical and drawing-office experience essential, preferably with Turbine Machinery.—Address full particulars, 3596, The Engineer Office. 3596 A

OXYGEN JET CUTTING MACHINERY

Warning.

GODFREY v. HANCOCK

Extract from Judgment by Mr. Justice Romer. 29th May, 1925.

Now it is said on behalf of the Defendants that once given the jointed frame carrying the cutter head at its extremity, no ingenuity was required to design a machine in which the cutter head can be moved about freely without any danger of fouling and by which the metal can be cut to the exact shape of a template. It is suggested that the placing of the template vertically above the cutter head for these purposes was an obvious thing to do. Now that the Plaintiff has done it, it is easy to say that it was an obvious thing to do. But no one had in fact done it, or, as far as I know, even thought of doing it. And the Plaintiff's machine is without question one of great utility and one that can do work of greater accuracy and at less cost than any pre-existing machine. **Evidence as to this was given by Colonel Starling, the Mechanical Superintendent of the British Thomson-Houston Works at Rugby. Mr. A. H. Brown, who is the General Manager of Babcock & Wilcox, Limited, also gave evidence as to the utility of the Plaintiff's machine and the advantages it possesses over other machines for cutting by the oxy-acetylene process.**

The truth is that the Defendants' machine belongs to the class of blowpipe machine in which the cutter is made to follow the lines of a drawing. The Plaintiff's invention relates to the class in which the path traced out by the cutter is determined by a template or other positive guiding member.

Existing machines designed for this purpose fall, broadly speaking, into two classes :—(a) those in which the blowpipe is directly guided over the work to be operated upon a template or the like ; and (b) those in which the lines on a drawing are traced over by a wheel or pointer, the movement of which produces a corresponding motion of the blowpipe.

Mr. Justice Romer has issued a Certificate of Validity for Claims 1, 2, 3 & 8.—Patent No. 130, 450, 27th July, 1918, Claim 1.—"An oxy-acetylene cutting appliance comprising a jointed frame capable of movement, so as to bring its end into any position in a horizontal plane, and an oxy-acetylene jet carried by said jointed frame, in combination with a template or former or adjustable guiding member mounted **above** the oxy-acetylene jet, substantially as described."

The effect of this Judgment is that anyone using a jointed frame carrying a blow pipe in combination with a template or former or any form of positive guiding means mounted above the cutter head will infringe the above Patent.

Users are equally liable with manufacturers and vendors to action for damages in cases of infringement.

The GODFREY ENGINEERING WORKS

Boundary Road, Westbury Avenue, WOOD GREEN, N. 22.

SITUATIONS OPEN (continued)

WANTED for Ceylon, Experienced TECHNICAL ENGINEER with commercial ability, having works experience of Petter or Vickers-Petter Engines. Excellent prospects for successful salesman. State salary and age.—Address, 3593, The Engineer Office. 3593 A

ASSISTANT MECHANICAL ENGINEER REQUIRED for Petroleum Refinery abroad ; age 23 to 25, unmarried, preference to candidate with sound theoretical training combined with practical experience. Agreement for three years, commencing salary according to qualifications, but not less than £315 per annum.—Write, with fullest particulars of education, training, and experience, "M. E. R.," c/o Street's, 6, Gracechurch-street, E.C. 3. 3570 A

ASSISTANT REQUIRED in Constructional Engineer's Office. Must be thoroughly competent to design and detail Steel Work and have good all-round knowledge of General Building Construction and the work entailed in the Lay-out and Erection of Factory and Workshop Buildings. Salary according to qualifications and experience.—Address, P2290, The Engineer Office. P2290 A

ASSISTANT to LONDON REPRESENTATIVE WANTED by Firm manufacturing Conveying, Elevating and Telpherage Systems, also General Plant, including Retort Settings. Practical workshop experience absolutely essential. Able to take own particulars. None but those filling these requirements need apply. Age, experience, and salary required must be stated if application is to receive consideration. —Address, 3578, The Engineer Office. 3578 A

CHIEF SURVEYOR and ASSISTANT REQUIRED for Preliminary Survey of Railway and Roads in Near East. Give full particulars of experience, qualifications, age, and salary required, also knowledge, if any, of foreign languages.—Address, P2282, The Engineer Office. P2282 A

COMMERCIAL ENGINEER REQUIRED for Brazil to act as local Director and to undertake Control of Factory in Sao Paulo for the manufacture of Structural Steel Work and large Riveted Steel Pipes. Must speak Portuguese fluently and have had experience of the country.—Apply in the first instance by letter, stating qualifications and salary required, to BRAITHWAITE and CO., ENGINEERS, Ltd., Broadway-buildings, Broadway, Westminster, S.W. 1. 3572 A

COMPETENT CENTRIFUGAL PUMP DESIGNER REQUIRED. State salary and full particulars.—Address, P2269, The Engineer Office. P2269 A

CONTRACTOR'S ASSISTANT, London ; Outdoor exp. building trades essential. Good scope to keen engineer. State exp. and wages required.—Address, P2295, The Engineer Office. P2295 A

ELECTRICAL DESIGNERS REQUIRED for Large Australian Company, with practical experience in High-voltage Power Transformers or Switchgear or Traction Equipment. Salary £600 to £1000, according to qualifications ; passage paid. State full particulars in confidence. Interviews, London.—Address, P2274, The Engineer Office. P2274 A

ENGINEER WANTED, with Initiative, to Take Charge of Hot Rolling Mills, Wire Drawing, Cold Rolling and Power Plant, including maintenance and construction. Thorough mechanical and electrical experience essential. Permanency for reliable and qualified engineer.—Address, stating age, experience, and salary, 3598, The Engineer Office. 3598 A

WORKS MANAGER.
FIRM of MECHANICAL and ELECTRICAL ENGINEERS in Manchester district, employing 250 to 300 hands, REQUIRE virile MAN, sound in policy, and with thorough knowledge of economical production. Applicants should state full particulars of experience, salary required, and when at liberty.—Address, 3588, The Engineer Office. 3588 A

MANAGER REQUIRED for Small General Engineering Works in West Midlands. Opportunity for man capable administrating business, obtaining work, and handling machines. State experience and salary.—Address, P2276, The Engineer Office. P2276 A

OLD-ESTABLISHED Firm of World Reputation, making High-grade Tool Steels, Alloy Steels, Steel Castings, REQUIRES TRAVELLER for Birmingham district, and also London. Applicants with some knowledge of metallurgy and heat treatment are invited to send full particulars of their qualifications. —Address, P2297, The Engineer Office. P2297 A

REPRESENTATIVE REQUIRED for London District, with experience preferred as Heating Engineer, to call upon architects, consulting engineers, &c., with a view to obtaining inquiries for Heating and Ventilating Plants, Cast Iron Pipes and other manufactures. Must be energetic, of good address, and well known amongst architects. Good income assured to a suitable applicant.—Address, P2255, The Engineer Office. P2255 A

THE SERVICES of a REPRESENTATIVE REQUIRED by a well-known Engineering Firm. Age 25-30. Sound commercial experience coupled with technical and practical knowledge essential. Preference given to good connection with Colour and Chemical Manufacturers in the Manchester district and Northern Counties.—Address, stating education, details of career, and salary required, 3612, The Engineer Office. 3612 A

TRADE MARKS.—WANTED, Experienced British and Foreign TRADE MARKS AGENT to control Industrial Property Department of International Organisation. Substantial salary to one with good knowledge of French and German. State fully education, experience, age.—Address, 3586, The Engineer Office. 3586 A

WANTED, LEADING DRAUGHTSMAN, Thoroughly experienced in calculations, getting out designs, and supervising preparation of finished working drawings of Heavy Railway Bridges.—Address, 3611, The Engineer Office. 3611 A

CHIEF DRAUGHTSMAN WANTED for Large Marine Engineering Establishment engaged on the highest class of work, including Machinery for Naval, Passenger and Merchant Vessels. Applications, which will be treated in strict confidence, should give full particulars of experience, stating age and salary required, and be accompanied by copies of recent testimonials.—Address, "MARINE," Wm. Porteous and Co., Advertising Agents, Glasgow. P2278 A

CONSTRUCTIONAL STEEL WORK.—WANTED, a really first-class and reliable DRAUGHTSMAN as Leading Hand, to Take Charge of Large Jobs. Good wages to suitable applicant.—BANISTER, WALTON and CO., Ltd., Trafford Park, Manchester. 3583 A

DRAUGHTSMAN, Experienced, WANTED IMMEDIATELY, accustomed to Lift Lay-out Design and Estimating Drawings.—Address, 3600, The Engineer Office. 3600 A

DRAUGHTSMAN REQUIRED, Accustomed to the design of Steel Towers, Light Constructional Steel Work, &c. Applications, which will be treated in confidence, must give experience, age, and salary required.—Address, 3571, The Engineer Office. 3571 A

DRAUGHTSMAN REQUIRED, Accustomed to Elevating and Conveying Machinery. Experience in Constructional Steel Work an advantage State age, experience, salary, and whether married or single.—Address, 3587, The Engineer Office. 3587 A

For continuation of Small Advertisements see page 3.

A Seven-Day Journal

A New Thames Embankment Scheme.

IT is sixty years or so ago since the north bank of the river Thames between Westminster and Blackfriars Bridge was converted into the Victoria Embankment as we know it to-day. The south bank remains much as it was with its wharves and its expanses of mud at low tide. In connection with the inquiry now being conducted by the Royal Commission on London Cross-river Traffic, a suggestion is being circulated that the south bank should be reconstructed after the manner of the opposite side. There can be no doubt that the Victoria Embankment, busily thronged as it is, would be still more used by all kinds of traffic were there no restrictions in force, and that a similar embankment on the south side would do much to relieve congestion. The problem to be faced is, however, a much more difficult one than that successfully overcome in the 'sixties of last century, for on the south bank there is an almost continuous succession of power houses, cold storage establishments, and other buildings, which all demand unrestricted access to the river. The problem is not insoluble, but in the opinion of some the scheme will be found too expensive to undertake. It may perhaps be worth recording that the plan for the north embankment as originally prepared by Mr. Bazalgette, embodied between Temple Gardens and Blackfriars Bridge a roadway carried on arches, designed to permit barges and lighters to pass beneath and so obtain access to docks lying between the roadway and the shore. These docks do not exist to-day, their place having been usurped by the District Railway constructed subsequently and covered over. It is just possible that a similar scheme might be found practicable on the southern bank.

A Proposed New Thames Bridge.

ANOTHER proposal mentioned at one of the early meetings of the Royal Commission on London Cross-river Traffic, was the construction of a high level bridge across the Thames at Woolwich. This bridge, the scheme for which is associated with the name of Mr. W. R. Davidge, President of the Town Planning Institute, would start near the South Circular-road, Woolwich Common, and would end on the other side in an easy gradient leading down to the Barking By-pass road at Beckton. It would be carried across the river by a single span of 1140ft., and would afford beneath it a clear height of 160ft. According to those interested in the scheme, the bridge would have two 10ft. footpaths and a 40ft. roadway, and would cost about £3,500,000 to construct. Each of the principal towers would contain four lifts, each capable of holding two motor vehicles in addition to separate lifts for pedestrians. The bridge on the north side would be continued across the docks, each dock being bridged by a single span. Vehicles would be able to pass direct from the ship's side by way of the lifts on to the bridge, and from thence on to either the north or south circular roads. A bridge at this point, it is held, would form a magnificent gateway to London, and would relieve much of the cross-river traffic congestion higher up. The proposed bridge would have a total length of two miles and, in conjunction with its height and the length of its spans, would when executed, be a noteworthy engineering structure.

A Transatlantic Flight Disaster.

ON Tuesday of this week, September 21st, the Sikorsky three-engined biplane, a huge machine produced in America for the purpose of flying non-stop between New York and Paris, met a disastrous end just after it had started on the journey. The machine, it would seem, was too heavy to lift itself properly with its full load of fuel and other stores on board for the Transatlantic trip. It failed to take off in a normal manner, damaged one of its landing wheels, and overshooting the prepared ground, crashed and burst into flames. The pilot—the French airman, Captain Fonck—and his assistant, Lieut. Curtin, of the United States Navy, escaped with little injury, but the mechanic and the wireless operator lost their lives.

The French Eight Hours' Day.

ONE of the measures which it is proposed to adopt in France for the stabilisation of the franc is a modification of the law limiting the hours of labour. It is argued that the only way to prevent the continuous inflation of costs which is hampering enterprise in all directions, is to increase production, which can be done by allowing men to work more hours than at present if they desire to do so, and thereby benefit the State as well as themselves. An appeal for a change in the existing legislation is being made by Chambers of Commerce and by various commercial and industrial associations. The case in favour of a longer working day has been put with particular force in a letter which a well-known Senator, Monsieur Josse, has sent to the French Premier declaring that the application of the existing law is "as ruinous, dangerous and miserable as it is illegal." It prevents the country from producing enough to live upon and from building sufficiently to provide decent accommodation, and while living costs advance, the situation of the country becomes steadily worse. The application of the law is illegal because it must be revised when other countries fail to fulfil the same international obligations. Italy has abandoned the eight hours' working day, and in some other countries it is observed with extreme laxity. The law can also be suspended in case of national necessity, and the necessity of working more hours in the national interest was never so great as it is now. Monsieur Josse estimates that the eight hours' working day has already cost the country more than 50 milliard francs. It is significant that while urgent appeals have been made for a long while past in favour of more working hours there has not been a single voice, apart from that of the Miners' Union, raised against the proposed change in the existing legislation.

The Blue Star Liners.

ON Tuesday, September 21st, there was launched from the Birkenhead yard of Cammell Laird and Co., Ltd., the liner Andalusia, which is the second of the three geared turbine passenger and cargo vessels which that firm is building to the order of the Blue Star Line, Ltd., of London. The first ship, the Almeda, was launched thirteen weeks ago, and work on the third vessel is well in hand. By an interesting coincidence, a sister ship, the Avila, one of the two sister liners for the same owners which are being built by John Brown and Co., Ltd., was launched at Clydebank on Wednesday, September 22nd. It is understood that the whole fleet of five vessels will be launched by November. The new liners are 510ft. between perpendiculars, with a breadth, moulded, of 68ft., a depth, moulded, of 37ft. 3in., and a measurement of about 14,000 gross tons. They are equipped with first-class state-room accommodation for about 180 persons only, which is distributed over four decks. The 'tween deck spaces below the upper deck and also the holds are insulated for the carriage of meat cargoes. Twin-screw propelling machinery of the single-reduction geared turbine type will be installed for a designed output of about 8000 shaft horse-power. The boilers are of the cylindrical marine pattern, designed for a working pressure of 200 lb. per square inch. They are to work under forced draught, and will be equipped to burn either oil fuel or coal. The Blue Star Line has also under construction four large 12,000-ton refrigerator ships, two of which are being built by Lithgows, Ltd., of Port Glasgow, and two by Palmers' Shipbuilding and Engineering Company, Ltd., on the Tyne. The first of these ships, which has been constructed by Palmers, Ltd., should be ready for trial in about six weeks.

Lloyd's Register of Shipping.

THE report of Lloyd's Register of Shipping, which was issued this week, shows that the operations of that Society for the year ended June 30th, 1926, have been affected but little by the industrial disturbance attending the coal dispute. It is anticipated, however, that the full effect of the stoppage will be a serious one, as is already foreshadowed by the falling off in the amount of new work coming to hand. In the year under review plans for 361 new vessels aggregating some 1,089,360 gross tons were passed by the Committee. Of this amount of new tonnage, no less than 68·3 per cent., or 744,030 tons, is to be built in Great Britain and Ireland and 31·7 per cent., or 345,330 tons, constructed abroad. The Committee has assigned classes to 419 new vessels during the year, representing a total of 1,330,507 tons, which is a slight increase over the figures for last year. It is of interest to note that the German tonnage constructed to the Society's classification shows an increase of 140,000 tons over last year's figure. At the end of June, 1926, the total number of mercantile vessels afloat which held the classification of Lloyd's Register amounted to 29,172,698 gross tons, which is the highest figure which has ever been recorded. At that same date there were also under construction to the Society's classification 297 vessels of 1,391,033 gross tons, making an aggregate of shipping which holds or intends to hold the classification of Lloyd's Register of 9854 vessels, representing a total of 30,563,731 tons gross. The usual interesting statistical tables accompany the report, in which also brief references are made to notable steam and motor ships surveyed during the year and the improvements in hull and machinery design. We note that over 7750 copies of the 1926–1927 edition of the Register Book have been issued, and that it has also been found necessary to publish new editions, in French and German, of the Society's Rules for Tests of Materials.

The Coal Dispute.

WITH the definite rejection by the coalowners' district associations of the Government's suggestion for a three-party conference, the Prime Minister, recognising that it was not within the Government's power to bring about such a meeting, proposed to the miners' leaders that work should be resumed at the pits on provisional district settlements. The owners in all districts, he pointed out, while averse to a national settlement, were willing to observe the main principles that such a settlement would be designed to secure. If the miners would return on provisional district agreements, Mr. Baldwin promised them that the Government would secure by legislation the proper application of those principles by means of the establishment of a national appeal tribunal. The object sought was to secure a speedy resumption of work by means of satisfactory district settlements combined with national supervision. The proposed tribunal would, on request from either side, review any matter dealt with by a provisional settlement provided such matter was of a kind which up to July, 1925, was customarily dealt with by national settlements. Every man affected by an award of the tribunal made in modification of a district settlement would be entitled by law to receive wages in accordance with the tribunal's decision. From the outset it was fairly clear that the miners' leaders did not feel attracted by Mr. Baldwin's proposals. They, however, met in London on Monday and Tuesday last, fully discussed the suggested scheme, and subsequently met the Prime Minister.

The Return of the Miners.

IT is estimated that up to the end of August 87 million working days were lost by the miners taking part in the present dispute. The seriousness of that figure should not be minimised, but the facts that after a stoppage which has now lasted approximately 150 days the country's industries are still far from being stopped, that unemployment is actually decreasing, and that imports and exports, excluding coal, are being maintained at a fair level, contain considerable cause for satisfaction. It is now abundantly apparent to all, including the miners themselves, that the stoppage of work in the mines cannot be used to exact terms from a country held to ransom. The importation of foreign coal and its free handling by the railway and other workers have saved the situation, but the miners themselves by working vigorously at outcrop seams have done no small thing to help the nation to surmount its troubles. The drift of the men back to the mines on terms arranged locally is now also becoming an important factor in alleviating the shortage of fuel. Recent figures place the number of men engaged in the mines at over 81,000, while with outcroppers the number actually producing coal in the country is believed to total about twice that figure. Between the mines and the outcrop seams something like half a million tons of coal are being produced each week. Certain of the miners' leaders seek to minimise the significance of the numbers returning to work, and dwell on the fact that the figure now reached, including all workers, is not 10 per cent. of the total number of miners in the country. But since it is extremely improbable that the mines will be able to employ much more than 600,000 men, instead of the 1,000,000 before the strike began, the actual percentage is nearer 16 per cent. than 10 per cent. The important fact is, however, that the return is daily growing in volume, and there can be no doubt that behind the scenes the drift back is causing the leaders considerable anxiety. We may credit them with the intelligence to see that with the present rate of return to work the termination of the struggle must be automatically reached in a few weeks.

The Decline of the Sailing Ship.

THE sixth annual report of the British Sailing Ship Owners' Association, Ltd., which has just been published, shows that for the year under review, 1925–1926, there is still a decline in the actual number of sailing ships in service, as recorded by Lloyd's Register, and the returns of the Registrar-General of Shipping and Seamen. Although during the period between June, 1925, and June, 1926, Lloyd's Register records an increase of 300,000 tons in the total world tonnage of steam and motor vessels, the sailing ships classified in that Register were reduced by a total of about 150,000 gross tons, leaving 2,112,000 gross tons as the world total recorded by Lloyd's Register. The returns of the Registrar-General of Shipping and Seamen show that in the period extending from July, 1925, to June, 1926, 151 sailing ships, representing 17,391 gross tons, were added to the United Kingdom Register, which figure includes 84 new vessels with a total of 11,140 gross tons, the majority of which were built in the United Kingdom during that period. The same returns further show that 223 sailing ships, of 19,188 gross tons total, were removed from the United Kingdom Register for various causes. Over the same period of time, 74 vessels, with an aggregate of 6077 gross tons, were broken up. The report states that the sailing ship industry has shared in the depression which has continued over the period in review and which has been accentuated by the general strike and the coal dispute. To a small extent, sailing ships have benefited by the diversion of cargoes from steamers which have been unable to obtain bunkers; but this is to be looked upon as only a temporary advantage, which will, in all probability, be lost with the conclusion of the coal strike.

Scientific and Industrial Research in Holland.

By Dr. W. ROSENHAIN, F.R.S.

THE high place which Holland occupies in physical science is, of course, well known to those familiar with the scientific activities of Europe. The names of Lorentz and Kammerlingh Onnes are familiar as those of leaders of physics; the recent death of the latter was a world-wide loss to science, while not only the scientific eminence but the charming personality of Professor Lorentz became apparent to all those who were fortunate enough to hear him deliver the May Lecture to the Institute of Metals in London a little more than a year ago. Yet despite this knowledge of the scientific attainments of the Dutch, a visit to some of the leading physical laboratories of the Netherlands comes as a revelation to anyone who is inclined to think mainly of England, Germany and America—and perhaps France—as leaders in this direction. As splendid examples of Dutch achievement on these lines, one of her Universities and one industrial laboratory may, perhaps, be taken. A detailed account of the equipment and work of either the Physical Laboratory of the State University of Leyden or of the Research Laboratory of the Phillips Lamp Company at Eindhoven would, no doubt, prove too scientically technical for the present purpose, but a brief account of these two laboratories in somewhat general terms may prove of interest and provide a useful basis for comparison with the corresponding institutions of this and other countries.

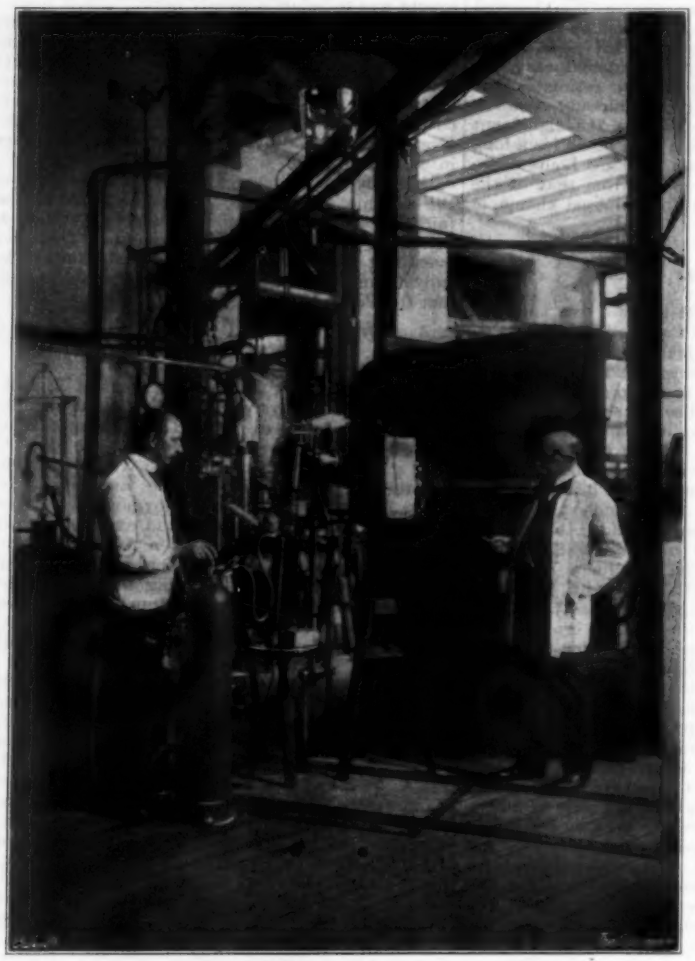


FIG. 1—LIQUID HELIUM PLANT AT LEYDEN UNIVERSITY

THE LABORATORY AT LEYDEN.

The Physical Laboratory at Leyden is famous as the scene of the great work of Kammerlingh Onnes in the production of exceedingly low temperatures, culminating in the liquefaction of helium and the attainment of a temperature estimated as 0·8 deg. K. or "absolute." A photograph, provided by the kindness of Professor J. de Haas, one of the present directors of the laboratory, and reproduced in Fig. 1, shows the plant used for the liquefaction of helium, with the figure of the late Kammerlingh Onnes standing before it. The figure at the side is that of a leading artificer who contributed largely to the success of the work. Liquid helium, as obtained in this plant, is the result of a cascade process, the first stage being the production of large quantities of liquid air. The plant in which this stage is carried out is illustrated in Fig. 2; actually two liquid air-plants are installed, one of an older type and another of the most modern Linde-Hampson type. The liquid air thus produced is used for the cooling of hydrogen, which is in turn liquefied in the plant illustrated in Fig. 3. By means of liquid hydrogen the cooling and subsequent liquefaction of helium is attained in the plant illustrated in Fig. 1. Just prior to his death Kammerlingh Onnes had attempted to produce solid helium by the rapid evaporation of the liquefied gas under greatly reduced pressure. A whole battery of mercury-vapour pumps, working on the Langmuir principle, was installed and arranged to work in parallel so as to remove the evaporated helium as rapidly as possible. This was never achieved, but, as already recorded in THE ENGINEER, the solidification of helium under pressure has now been accomplished by Professor Keesom.

In order to give some idea of the scale on which these liquefied gases are produced and used for research purposes, the following figures, supplied by Professor de Haas, may be quoted:—In 1923–24, the liquid air used amounted to 5962 litres and the liquid hydrogen to 1323 litres. Helium was liquefied nineteen times, but it is difficult to state the volume of the liquid produced, as a great part of it was immediately evaporated during the process of cooling down the research apparatus in which it was studied. The relative size of the hydrogen and helium plants is, however, indicated by the fact that while the hydrogen plant absorbs 24 horse-power, the helium plant takes 4 horse-power. On a recent occasion when helium was liquefied—early in June—it is estimated that 6 litres of liquid helium were produced and used.

With these really magnificent resources available, it is not surprising to find that a considerable number of workers from all over the world come to the Leyden laboratory to carry out low-temperature researches. A number of airy, well-lighted rooms on the ground floor of the laboratory are devoted to research, most of the workers having separate rooms. These investigators include, besides some seven Dutch researchers and eleven Dutch assistants, some eight workers from various parts of the world, including France—Professor Jean Becquerel—Germany, America, Sweden, Japan, Russia and England. The problems under investigation include the coefficients of thermal expansion of solids at very low temperatures, the dielectric constants of liquid gases, and the spectrum of crystals of solid nitrogen when excited by electron bombardments of various velocities—the latter in connection with Professor Vegard's theory of the auroral light. While much of the research work naturally centres round extremely low temperatures and the remarkable phenomena which occur in highly cooled matter, there is another field of work which is also a speciality of this great laboratory. This is typified by the huge electro-magnet illustrated in Fig. 4. With this magnet, Professor de Haas has already measured fields up to 75 kilo.-gauss and hopes to reach 90 kilo.-gauss. Work in very strong magnetic fields is thus another important feature of the research activities at Leyden.

The laboratory which constitutes the teaching as well as the research centre of the University of Leyden for physics, formerly under the sole directorship of the late Kammerlingh Onnes, is now under the dual direction of Dr. W. H. Keesom and Dr. W. J. de Haas, who enjoy equal status and divide the work between them. To the scientific visitor, the whole organisation with its splended equipment and staff and contingent of distinguished research workers, presents an admirable picture of scientific activity, fully maintaining the high place of Holland in this branch of science.

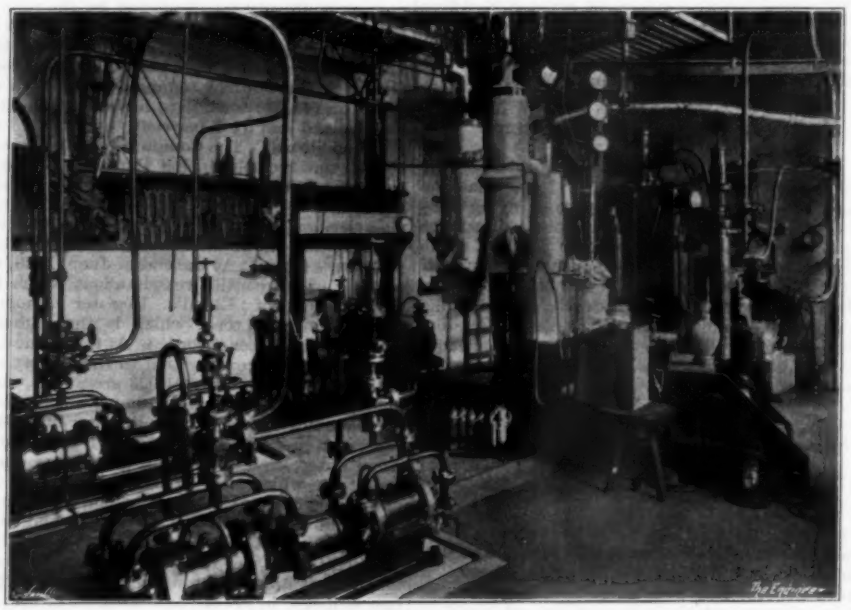


FIG. 2—LIQUID AIR PLANT

THE LABORATORY AT EINDHOVEN.

The Research Laboratory of the Phillips Lamp Company at Eindhoven naturally presents a contrast to the University laboratory which has just been briefly described. It is situated, to begin with, not in the heart of an ancient city of the Netherlands, near the banks of a typical canal and surrounded by houses of mediæval style, but in the open fields of the countryside, near a railway line and a short distance from the small town—little more than an overgrown village—of Eindhoven. Actually in the town, and indeed constituting a large part of it, is the great Phillips lamp factory itself, and it is interesting to note that the research laboratory has been built on an entirely independent site at some little distance—a mile or so—from the factory. At the same time, an experimental factory has been erected adjoining the research laboratory and forming, to a considerable extent, part of the same scheme. This recognition of the need of a properly organised and equipped intermediate step between research laboratory and production plant shows a very real appreciation of the needs of development on a scientific basis.

The general appearance of the laboratory buildings is shown in Fig. 5. It will be seen that the buildings are of the single floor or "bungalow" type. As a result, the whole establishment, which is rectangular in plan enclosing a wide quadrangle, occupies a large area—one of the main corridors has a length of over 330ft. The system, however, has many advantages in allowing the separation of more or less incompatible activities, while it simplifies construction and the carrying of the many supplies—water, gas, hydrogen, vacuum, electric current of all kinds—to the various laboratories.

The general equipment of this laboratory is impressively good and extensive; it can fairly be said that all the resources of science and technology are here put at the disposal of investigators in ample measure—these resources being at least as good as, if not even better than, any available in the best laboratories of this country or in America. But perhaps the most interesting feature of this industrial laboratory is the nature of the work that is mainly carried on there. While the purpose of the laboratory is clearly and frankly industrial—*i.e.*, to improve the business of the Phillips Company—the method of achieving that

result has been conceived in the broadest spirit, and the longest views are taken. As a result, extremely fruitful work has been done, and the laboratory itself has been considerably extended beyond what had originally been planned. On going round the laboratory, it is striking to find that only here and there does one encounter work in progress that deals directly with any specific problem of the company's

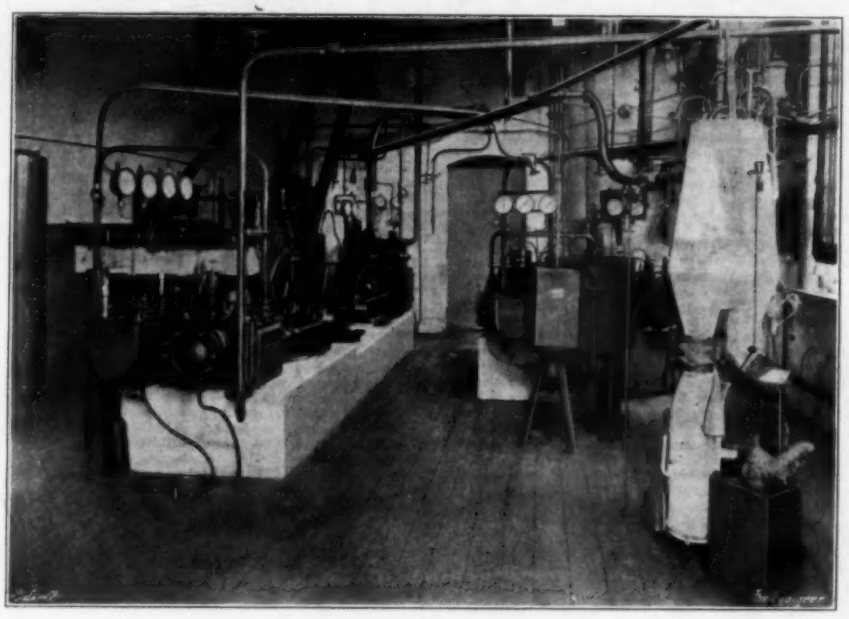


FIG. 3—LIQUID HYDROGEN PLANT

manufacture—experiments on new "valves," on a new loud-speaker from which, incidentally, it was surprising to hear the peals of "Big Ben" ringing through the building at 11 a.m. are what one would expect to find. On the contrary, however, room after room of this widespread building is devoted to research on purely fundamental problems. Thus there is a chemical division of the laboratory in which the separation of hafnium from zirconium is carried out on a considerable scale. These two, and others of the less known metals, such as titanium, thorium, &c., are receiving particular attention, and it was interesting to see not only a stick of pure boron, hard enough to cut—not merely scratch—glass, but alongside of it rods of pure zirconium, which are so ductile that they can be readily rolled into strip and drawn into fine wire. A piece of the fine zirconium wire can be ignited with a match and burns with a greenish flame. Unlike burning magnesium, however, it does not give off a cloud of oxide; the zirconium oxide produced by the combustion retains the shape of the wire, and falls off under its own weight as its length increases. As the oxide of magnesium is not appreciably volatile,

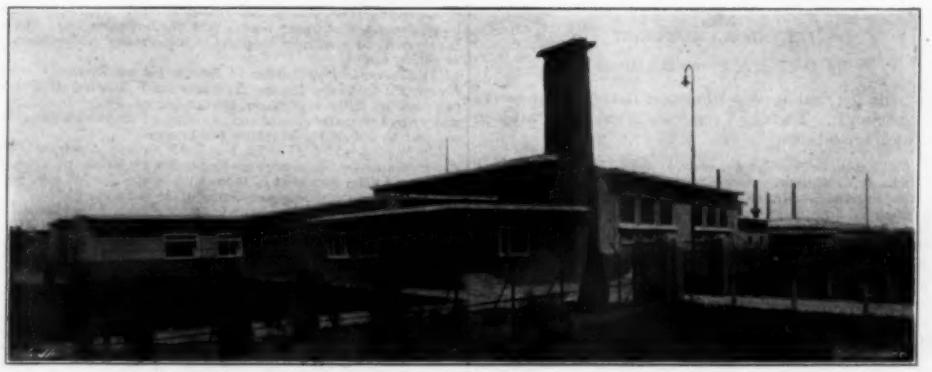


FIG. 5—LABORATORY BUILDINGS, PHILLIPS LAMP COMPANY, EINDHOVEN

the difference in the behaviour of burning magnesium must be due to the fact that magnesium metal itself is volatile, and that probably the greater part of it is burnt, when a wire or ribbon is ignited, in the condition of vapour, thus leaving the oxide suspended in the air as a cloud of exceedingly fine particles.

The manner in which ductile zirconium, hafnium and titanium are produced has been fully described in papers recently published by Drs. van Arkel and De Boer. It may be interesting to recall, however, that the ductility of these metals depends upon their high purity, and more particularly on their entire freedom from oxygen and nitrogen. This latter condition is secured by effecting the reduction of the metal from a vapour—actually, the vapour of the iodide is used—by contact with an incandescent tungsten filament in an otherwise highly evacuated glass vessel. The tungsten filament becomes covered with a deposit of the pure metal, and, provided that a sufficient supply of the iodide vapour is available and that the temperature of the thickening filament is properly maintained by steadily increasing the heating current, rods of metal up to 4 mm. or 5 mm. in thickness can be grown. In such a rod the tungsten filament remains as a core, but it is negligible as an impurity. The results achieved in this way are very striking, and are likely to open up important developments. No doubt the first application of these new wire materials will be for use in electrical apparatus, particularly in valves, &c., and for purposes of that kind the filament method may prove workable as a means of producing the metals. There is no reason to doubt, however, that it should be possible to adapt the principles of the method employed to production on a much larger scale. As so frequently happens, the laboratory curiosity of to-day—among which ductile zirconium and hafnium can still be counted—may well become an important industrial material to-morrow.

Another line of activity pursued in the laboratory is an interesting example of the way in which the investigation of seemingly abstruse physical problems may lead to important manufacturing improvements. The physical phenomenon investigated in this case was the dispersal or "sputtering" of metals which occurs when a rod or wire is made the cathode in a discharge tube in an atmosphere of an inert gas. It was found that a wire when treated in this way was steadily reduced in diameter, and that this reduction took place with great uniformity, since projections suffered most rapid dispersal. A valuable application to practice has been found in this discovery in the production of very fine wires—the process makes it possible to reduce wires to a diameter far smaller than can be obtained by any drawing process, while the surface of the resulting filament is particularly smooth and uniform.

In a laboratory organised and directed on these lines, it is not surprising to find work in progress on a great variety of physical and chemical problems which, superficially, have no immediate connection with the work of the lamp factory. What may perhaps be termed "electron physics" plays a large part in this work, but the study of the constitution of the atom itself, of photo-electric phenomena, and of the behaviour of isotopes of various gases are also included in a list that would be far too long and technical to be included here. Perhaps the most striking feature is the very rapid development of the whole laboratory. Begun in 1914 as more or less a routine testing laboratory in a few rooms in the lamp factory itself, the first portion of the present buildings was begun in 1922. The western and northern wings were taken into use in December, 1922; the easterly wing, in which the chemical division is housed, was added in 1924, and already the fourth wing has been completed. No doubt the satisfactory planning and arrangement of the whole establishment is mainly due to the fact that the director of the laboratory—Dr. G. Holst—was largely concerned in its design. This is an important feature, in view of the fact that many laboratories are built and even in part equipped before the man who is to be at the head of the new institution has arrived on the scene.

No attempt has been made above to give any detailed description of either of the two great Dutch research laboratories, but enough has perhaps been said to indicate their first-rate importance. The physicists of other countries must certainly look upon

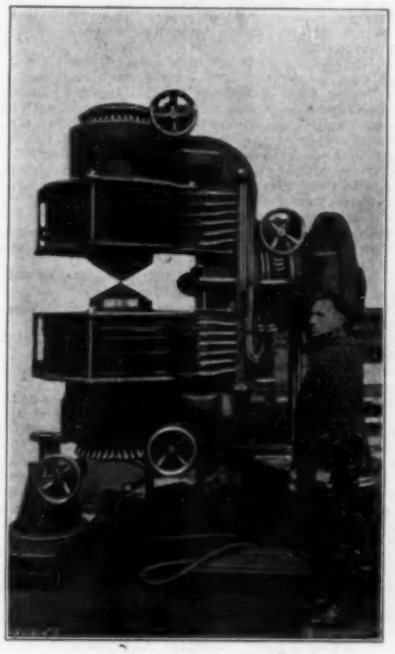


FIG. 4—LARGE ELECTRO-MAGNET

these institutions of the Netherlands with the greatest respect, which will be coupled in many cases with a considerable degree of envy. The industrial reward also is a factor which we cannot afford to ignore, from either the individual or the national point of view.

The World Power Conference at Basle.

No. III.*

SECTION A of the Conference was concerned with Utilisation of Water Power and Inland Navigation. In view of the immense range of the subject, the papers presented were divided into two parts. The first set, dealing with Utilisation of Water Power, was summarised by Monsieur E. Payot, and the second, dealing with Inland Navigation, by Monsieur A. Strickler. An abstract of these reports is given below.

UTILISATION OF WATER POWER.

By E. PAYOT.

Seventeen reports are summarised in three groups in this general report.

Group 1: General Considerations and Hydraulic Constructional Work.—Some extremely interesting questions are broached in the treatment of individual portions of installations. For example, the security of the river bed downstream from a weir or dam is of the greatest importance. Hydraulic engineers are still seeking for a reliable method of protecting the river bed below the weir, especially a method which will be applicable to all typical cases. Whilst some engineers—at least, this was the case up to some time ago—are of opinion that, provided the foundations of the weir go deep enough, the whirlpool cannot do damage and reaches a certain permanent state, others endeavour to design the weir sill and the spillway in such a way that the kinetic force of the overflow is destroyed in the whirling mass of water, so that, below the point where the bed has been protected, no whirlpool is formed, or only in an insignificant degree.

Of considerable importance, especially in connection with the protection of the river bed, is the question of the construction of weir sluices for low head stations. Special attention requires to be given to making the sluices watertight and to protecting the roller frames from shock in order to avoid vibration.

The construction of the turbine inlets which include arrangements for cleaning the strainer racks, is of eminent importance for the reliable working of the station. Mr. Gruner (Switzerland) emphasises with justification the great value of the high water plate and, further, that the inlets should connect up with the weir without juttings or angles.

Mr. Büchi (Switzerland) discusses high head power stations

* No. II. appeared September 17th.

in his report. Great attention requires to be paid to details in connection with movable dams, especially those portions which are unavoidably exposed to wear, owing to the action of solid matter. The design of the entrance works tends towards a certain type which should be established on the basis of general experience in order that a study of this particular portion of the structure should only be necessary in special circumstances.

The accumulation of a water supply for high head stations is achieved in one case by damming rivers in which there was formerly no natural reservoir, and whose course down the valley is interrupted at a suitable spot by an artificial dam. It is this type which forms the major portion of storage stations in Switzerland. In other cases the water is impounded by partly raising the level of already existing lakes by means of a dam or wall and drawing off the water to a corresponding degree by means of low-lying conduits. In all cases, the weir, be it in the form of a wall or a dam, represents the most important and usually the most expensive part of the storage works. Earth dams assume various forms. It is more usual to meet, however, dams built of masonry and arched dams, about the construction of which opinions are still divided. Gravity type dams are governed to a certain extent by the buoyancy. It is a matter of great importance to clear up the question of in how far this effect is to be taken into consideration in calculations, because this aspect has considerable influence on cost of construction.

Engineers have assumed a new and difficult task in that, in order to reduce costs, they endeavour to carry out conduits on an incline whenever the nature of the soil allows. These conduits are provided with an iron shell. The construction, calculation of the dimensions and the connecting up of this shell present extraordinarily interesting problems. Very instructive tests were made on a model conduit for the inclined conduits of the Oberhasli power station.

Mr. Konz (Germany) treats in his report, first of all, of the work, begun in the year 1921, on the 200-kilom. long stretch of the Neckar from Mannheim to Plochingen to make it an efficient navigable waterway for ships of 1200 tons, with twenty-six reaches, and of the simultaneous utilisation of all the available water power of the river. The method of construction adopted for the weirs is worthy of attention. In view of the fact that the river volume fluctuates very much, the energy obtained will doubtless only be utilisable as complementary to, and a substitute for, that obtained thermally. Nevertheless, the construction of storage stations is anticipated. The canalisation is the principal objective, and the utilisation of the water power is intended to assist in increasing the economic value of the whole scheme.

A second great project foresees the utilisation of the water power of the Iller between Ferthofen and Ulm.

Mr. Berdal (Norway) introduces us to the exploitation of the Glommen and its tributaries, particularly the efforts towards regulating these streams. The Glommen and its tributaries, together with the various lakes suitable for the storage of water, will probably turn out to be one of the finest hydraulic power systems in the world.

A special question, namely, that of the regulation of lakes, is treated by Mr. Schmidt (Sweden). He describes the guiding principles prevailing in Sweden, based upon the Swedish Water Law of the year 1919 for the regulation of lakes.

The report of Mr. Karlsson (Sweden) discusses movable dams. Most dams built in Sweden have to pay particular attention to the question of log transport, and the formation of ice has also to be taken carefully into consideration when designing a dam. Thus, ingenious methods have been adopted in Sweden for heating the sluices electrically, and especially their guides and stanching arrangements. In designing the dam, special attention is paid to ensuring that the grooves are accessible, so that they can also be freed from ice mechanically. Mr. Karlsson rightly points out that the reliability of the sluices in winter does not so much depend on their construction as on the design of the piers.

The report of Messrs. Sundblad and Plass (Sweden) also discusses a special point in the realm of water power installations and gives a description of the dam construction of the Norrfors power station. The various forms in which ice occurs are described, and it is explained that the ice covering the reservoir prevents the formation of other-ice. The construction of the regulating dam was very noteworthy, because it could only be carried out at low water in winter. The experiences gained during the construction referred to are of outstanding importance for engineers who have to carry out constructional work in the mountains. Mention is made of another system of preventing ice formation at this dam, namely, forcing compressed air into the water

Group 2: Machinery and Switch Installations.—This group contains the reports dealing with water turbines, generators and switchgear in power stations. Let us consider, first of all, those which treat of the construction and operation of modern water turbines.

In the report of Mr. Ungerer (Germany) a description is given of the position reached by manufacturers of water turbines in Germany. He describes, first of all, the endeavours to make the efficiency correspond to the load. The report goes on to discuss the properties of the Francis turbine with and without gearing, and the propeller and Kaplan turbine and their sphere of application.

Developments appear to tend more and more towards the vertical type. In this type the vertical thrust bearings play a very important part. In the opinion of the general reporter, it seems very desirable to have a clear division between turbine and generator, and particularly the thrust bearing should be mounted on the turbine, instead of the usual method of placing it on top of the generator.

Another important problem is brought up by the high runaway speed of high-speed turbines. Where large machines are involved, the testing of the whole set, especially of the generator, for strength at runaway speeds, will probably meet with great difficulties. Turbine constructors therefore take precautions to supply safety appliances against running away. The question now is whether these appliances are quite reliable. The engineer in charge will require only a simple, easily inspected and absolutely reliable appliance. Otherwise, in view of past experience, he will be obliged to insist upon testing the generator at runaway speed. It is therefore as well that turbine builders should provide suitable reliable safety appliances.

Mr. Munding (Sweden) relates the development of water turbine design in Sweden. He discusses the utility and necessity of external governing, and stresses the point that internal governing is still used in Sweden with success.

Mr. Caflisch (Switzerland) describes the principles adopted by Swiss designers in the construction of the most modern types of turbines. He points out very correctly that structural, mechanical, and electrical engineers are only in a position to give their best by working in common and taking into consideration all decisive factors of a constructional or mechanical nature. The turbine with its necessary concrete setting and the foundations of the power-house form such a composite unit that this co-operation is absolutely necessary.

A special chapter, from the pen of Mr. Dubs, is devoted to the influence of the draught tube on efficiency. Interesting comparative tests are described. Water pumps, as used more and more for replenishing reservoirs having insufficient natural supplies, are also described.

The reports of Messrs. Wallem (Germany) and Wyssling (Switzerland) describe the development of the construction of electric generators, transformers and switchgear in Germany and Switzerland. Mr. Zachrisson (Sweden) gives details in connection with some automatic power stations which have been built in Sweden.

Dealing with the very interesting report of Mr. Wallem (Germany), we should like to draw attention to the question of whether the vertical or horizontal shaft is more advantageous for hydro-electric machinery. Mr. Wallem says that electrical engineers prefer sets with the horizontal shaft, but that the hydraulic engineer always prefers the vertical arrangement.

The protection of generators is another matter which requires to be cleared up, and, if possible, to a certain extent unified. Both from an economic and an operative point of view, weight must also here be placed upon the fact that only a comparatively cheap and, above all, simple appliance must be aimed at. A multiplicity of relays makes the operation more difficult, and their maintenance and constant inspection demand quite special knowledge on the part of the attendants.

Great progress can be reported in the construction of large transformers. An interesting fact is that the size of units is really only limited by transport possibilities on the railways. Attention is also paid to the initial compression of the coils, and mention is made of a solution which allows of subsequent adjustment without opening the oil tank. Circular coils are practically always used, together with forced cooling and oil conservator, for modern large transformers.

The design of modern switchgear installations tends to avoid the many-storey arrangement. Efforts are further made to carry out the so-called one-man system, i.e., to construct the installation in such a way that every operation can be carried out from one spot. In this case the isolating switches must also be provided with remote control. In cases where the outdoor installation is not practicable, or where the authorities manifest certain objections to outdoor installations, the so-called semi-covered construction is preferred, which presents an interesting solution.

In the report of Mr. Wyssling (Switzerland) on matters dealing with the electric equipment of Swiss hydro-electric power stations, practically the same questions are treated as in Mr. Wallem's report.

Mr. Zachrisson (Sweden) describes some smaller, but interesting installations in Sweden, which are called automatic installations. He points out, however, that the automatic gear has not reached that pitch of perfection which it has reached in America. The installations described by him indicate clearly the efforts in the direction of a one-man system. As far as possible, neighbouring power stations should be under control from a single point. The attendance of the affiliated stations then becomes simply a matter of visits of inspection and cleaning out the racks and breaking up ice. The reorganising of small power stations as automatic remote control plants permit of exploiting small stations which would otherwise be unprofitable, especially when they can be connected up to feed into a larger network.

Group 3: Progress of Water Power Development.—The reports in this section contain information with regard to the manner in which the utilisation of hydraulic power has been developed in different countries.

Mr. Mayehare (Japan) deals in his report "Utilisation of Water Power in Japan," with the manner in which the production and use of electric energy have progressed in Japan since the World Power Conference in 1924.

In Mr. Wyssling's report on the progress of water power development in Switzerland, mention is, first of all, made of the position of water power utilisation. He then refers to some interesting problems of great moment. In his introductory remarks Mr. Wyssling points out what a very large number of fairly small power stations exist in Switzerland, together with re-selling organisations. Even though these small stations work with high production costs for energy and the re-selling organisations have the disadvantage of excessive management expenses and the lack of skilled workmen, it is, nevertheless, these many small, and in some cases old-fashioned, primary power stations working together with the re-sellers, which have played a large part in introducing the use of electric energy into the remotest Swiss districts.

At the conclusion of his report, Mr. Wyssling states that in spite of the success which had undoubtedly been achieved in balancing the available with the consumed output, there are in Switzerland, even in years with a dry winter, water power resources available during some eight months, and that the supply is fairly constant and certain for five to six months. Mr. Wyssling calculates that with 2339 million kilowatt-hours of consumed energy, a total of 3250 million kilowatt-hours is available from the hydro-electric power stations at present existing in Switzerland. If the smallest stations are taken into account, for they are not included in the above figures, a round 1000 million kilowatt-hours of summer energy await development, even in a year with poor water supply. It must be remembered that this surplus power, which remains fairly constant for several months at a time, is only realised when the excess energy and output of the many power stations are combined. Its collection and distribution can, however, only take place if a close co-operation can be achieved among the various power stations and if the supplies available and the possibility of their utilisation be studied from day to day.

INLAND NAVIGATION.

By Dr. Ing. A. STRICKLER (Berne).

In this general report nineteen individual reports are dealt with. The chief reporter divides the subject into eight headings.

(1) *Conflicting or Similar Interests in the Utilisation of Power and Inland Navigation, where Rivers Used for Power Production are Concerned.*—Mr. Hoebel (Germany) deals in his report with some management questions on the basis of experiences hitherto made in Germany.

Mr. Ekwall (Sweden) treats of utilisation of water power and navigation on the Götaälv in Sweden, between Lake Vänern and Gothenburg, where two large power stations already exist at Trollhättan and Lilla Edet. Of particular interest are the experiences gained there with the formation of ice. Since the profile of the river has been corrected, and since the river has been used for power production, navigation is much less disturbed by ice in winter. Both needle ice and surface ice can be considerably restricted, partly by damming up the water and thus reducing the speed of the current, and partly by inserting ice booms at certain spots on the river in order to hold up surface ice.

At the first glance it might appear that navigation would be impeded by this ice formation, but experience has taught that vessels are not exposed to any great difficulties, or only in cases where a rapid current changes into a slower one and ice jams occur. In any case, the vessels have such powerful engines that they can mostly break through the ice. (On the Götaälv ships are not towed, but are self-propelled.)

Mr. Dupin (France), speaking of the use of dams as accumulating basins, mentions that fluctuations of as much as 10 cm. are to be allowed in the water level of the power stations planned on the canalised Seine between Paris and Rouen. In the case of some of the dams, the accumulated volume will thus reach 0·5 million cubic metres, which at low water when there is usually insufficient water for full exploitation, will enable one-fourth of the installed power to carry on for an additional two hours, and thus the economic value of the river will be greatly enhanced.

Mr. Dantscher (Germany) describes in his report the Viereth dam on the Main and the Passau dam on the Danube, and emphasises the necessity of either fully utilising or running off the volume of water in the upper reach, since otherwise in the reach lying below the power station fluctuations might occur in the water level and this might be a danger to shipping. In Mr. Dantscher's opinion, power stations must therefore not use dams as accumulating basins.

In the report of Mr. Strickler (Switzerland) the question is raised of the regulation of the water level at the weir according to the various annual fluctuations. He comes to the conclusion that, equally from the point of view of power production as of navigation, on economic grounds, the dammed up water level must be kept as constant as possible, i.e., at high and low water the level at the weir is not to be allowed to vary.

(2) *The Economic Utilisation of the Water Power on Navigable Waterways.*—Mr. Dupin (France) takes as an example the projected exploitation of the canalised Seine, and shows that under certain circumstances, the lower reaches of a river, used formerly for navigation alone, can also be utilised for power production. By combining some of the reaches on the Seine, useful falls of 3 m. to 5·5 m. at low water are obtained.

Messrs. Tillinger and Rosental (Poland) point out in their report that Poland still requires new waterways for her economic development. At the same time the power of these waterways is to be exploited. The authors are of opinion that this economic development is only possible providing the power stations have to construct only the central stations and supply the equipment, but that navigation completes the dams and canals at its own cost.

Messrs. Maurer and Vas (Hungary) describe in their report the regularisation and rendering navigable of the Soroksár arm of the Danube. On the 60-kilom. long stretch of this arm, which has only a very slight fall, hydraulic power is obtained and concentrated in two stations—1 m. to 3 m. fall. At first sight, these extremely small falls appear to offer no economic possibilities whatsoever. However, since quite unusual circumstances prevail, possibilities do exist. These favourable circumstances arise from the fact that here the power station does not require to construct a weir at its own expense—navigation bears the expense—and, in addition, that it is possible to supply energy to a district hitherto devoid of a supply, and in which the preponderating output is utilised for illumination which brings in relatively good prices.

Mr. Fontaine (Belgium) explains in his report that a new waterway is planned in Belgium for developing the coal mines of Campine on the plateau between the Meuse and the Scheldt for the purpose of connecting that district with Liége and Antwerp and thus allow of the economic transport of coal. The canal, which is intended to branch off from the Meuse near Lixhe below Liége and lead to Antwerp, will also supply the coal district with water, in addition to which, hydro-electric power will be generated at the falls of the five locks. The total utilisable fall will be some 50 m., and the projected flow 25 cubic metres per second.

Mr. Klink (Holland) describes the work begun in 1925 to render navigable the Dutch-Belgian Meuse between Eysden (southernmost point of the Belgian-Dutch frontier) and Maesbracht, as well as the canalisation and connecting up of the Meuse with the Waal near Nymegen for 2000-ton ships. After the completion of this waterway, the Dutch Limburg coal district will be connected with the Belgian industrial district on one hand, and with the Waal and thereby the Rhine, on the other hand.

Particular interest attaches to the description of the lateral canal between Maestricht and Maesbracht—Juliana Canal—because hydraulic power can also be utilised there. The canal is 34 kiloms. long and has a cross section of 169 square metres. The fall is 24 m., which is to be utilised at the three lock stretches of Born, 11·35 m.; Roosteren, 4·80 m.; and Maesbracht, 7·35 m. to 3·75 m. The power stations are to be constructed for a flow of 50 cubic metres per second, and this volume will be available for ten months in the year. The installed capacity of the three stations will be 7300 kilowatts altogether, and the possible annual output 57 million kilowatt-hours.

(3) *Movement and Deposit of Solid Matter (Gravel) in connection with the Utilisation of Rivers for Power Production and Navigation.*—The report of the management of the Danube Regularisation Commission (Austria) refers to the fact that in the Austrian Danube, which contains so much solid matter, the problem of removing this extraneous matter requires particular attention.

The management has carried out exhaustive experiments and calculations in this connection, and as a result of these experiments and studies it will probably be possible to deflect 300 to 400 cubic metres per second from the river, and by the construction of corresponding regulation works to maintain in the stretch where the deflection takes place a navigable fairway which would have 140 m. to 180 m. breadth and 2 m. depth at the lowest navigable water level.

Messrs. Halter and Schaffernak (Austria) also pay great attention to this question of solid matter. From their general observations, it is apparent that, from the point of view of the maintenance of existing river conditions, a power station which utilises a weir overflow, and by using a canal exploits the current of a river, represents the most unfavourable form which a station could assume.

The general investigation of the authors leads to the important conclusion that it is possible, with the help of regulation works in a stretch from which water is deflected—*i.e.*, between the points where the water leaves and then rejoins the river—to take practical measures to prevent a decrease in depth, owing to silting up.

(4) *Economic Possibilities of Navigation on Streams Used for Power Production.*—Messrs. Tillinger and Rosenthal (Poland) mention in their report on the projected Polish network of waterways that the cost of construction of these waterways will amount to 500,000 gold francs per kilometre.

(5) *The Speed of Flow in Navigable Canals Used for Power Production.*—In the report of Mr. Hoebel (Germany) attention is drawn to the fact that in Germany, in the case of new power and navigation canals, provision is made for a speed of flow not exceeding 0·70 m. per second, having consideration for the safety of navigation. In narrow canals and before locks, navigation is rendered very difficult with a strong current.

Mr. Klink (Holland), in his report on the Juliana Canal, discusses the question of the permissible speed of flow from another point of view, namely, from that of the economic working of navigation. He assumes that the current must not be so strong that the resistance of the barges, with an absolute speed of 4·8 kiloms. per hour—compared with the banks—is allowed to exceed a value of 1·0 kilos. per ton of useful load.

Mr. Fontaine (Belgium) mentions in his report that on a lateral canal on the Belgian Meuse upstream from the point where the Campine Canal branches off, as already mentioned, provision is made for a volume up to 280 cubic metres per second, with a cross section of 244 square metres. The greatest normal speed of flow is thus 1·2 m. per second. With traffic of 1350-ton ships—80 m. by 10 m. by 2·5 m.—the ratio between water cross section and ship's cross section is 10 in round figures.

(6) *Tugs for Inland Navigation: Their Methods of Propulsion and Engines.*—Mr. Zilcher (Germany) reports that previous experiences with tunnel screw vessels on rivers with restricted depth have not been very satisfactory, and that paddle tugs are still greatly superior to tunnel screw tugs. The reason lies in the fact that these screw tugs are greatly affected by fluctuation in draught, and this is not easily avoidable on long trips on account of the cargo and great consumption of fuel. Besides the efficiency of the screws in the tunnel is not very great, since the stress on the propeller vanes is usually too heavy. Mr. Zilcher is of opinion that future developments will come from the use of quadruple-screw tugs.

In connection with engines, Mr. Zilcher mentions that the simple four-stroke Diesel motor has maintained its reputation, especially for driving screws; also that the steam turbine is beginning to become popular for requirements of over 1500 horse-power.

Mr. Gebers (Austria) gives a report on experiments with partially submerged ships' propellers. These experiments have shown very good results, better than with any other propellers. However, the author points out that they can only be used

within restricted limits. A future can be prophesied for the new propeller in connection with fast motor boats, tugs in calm water and, above all, for fast passenger vessels.

Mr. Ostertag (Switzerland) reports that the steam turbine is only suitable for large tugs. The piston steam engine is quite equal to the turbine as regards steam consumption as long as requirements do not exceed 1500 horse-power; for smaller developments it is even superior. The author emphasises the great advantages of the Diesel motor.

Mr. Yokata (Japan) gives an account of the theoretical investigation of a propulsion and steering medium, much used in Eastern Asia, which he calls "Ro." Its efficiency is said to reach as high as 60 per cent.

(7) *Calculation Formulæ in Hydraulics (Speed Formulæ).*—Mr. Parry (Great Britain) recommends dropping, in the case of hydraulic calculations, all formulæ for the value c in the Chezy equation $v = c\sqrt{1\,s}$, and using in place thereof a number of experimentally obtained curves having as abscissa the logarithms of the well-known Reynolds' parameter $\frac{v\,d}{\nu}$ and as ordinates the values $\frac{r\,s\,g}{v^2}$. (It is naturally assumed that the movement of the water in regular channels, principally tubes, is uniform.) The author points out that these graphs are applicable in general equally to liquids as to gases at all temperatures and for all consistencies.

Mr. Parry proposes to the Sectional Meeting that a definition be given of the expression "specific roughness" $\frac{r'}{r}$ as the ratio of the size of asperities to the diameter or to the hydraulic radius of the channel. Obviously, this size would have to be understood as another parameter in the group of curves mentioned above.

(8) *Miscellaneous.*—Mr. Krogstad (Norway) describes the construction of the Fredrikshald waterway in Norway for floating logwood and the production of power. The station is one of 10,000 horse-power installed capacity, with two locks, each having four chambers.

The discussion covered a very wide ground. One point raised was the necessity of standardising the tests of hydraulic turbines, and Monsieur Ungerer proposed that the question should be referred to a special Commission. Monsieur Legouez, however, remarked that there were already a lot of commissions in existence, and it seemed to him that the International Electrotechnical Commission was just the body to concern itself with this matter. Monsieur Neeser supported this view strongly, and hoped that the question of the determination of the net head under which a turbine was working would also be referred to the same Commission. Mr. Patchell said that the Electrotechnical Commission was first established to settle questions of nomenclature, but there had lately been a movement to let that Commission undertake testing, its name being modified and its constitution strengthened. He proposed that the executive of the World Power Conference should meet the executive of the International Electrotechnical Commission, and settle the matter by means of a joint committee.

It was finally decided that the International Electrotechnical Commission should be approached with regard to the study of the question, with an expression of opinion that the Commission would co-opt specialists in hydro-electric power to assist it in its deliberations. This matter being disposed of, the Conference returned to the question of turbines, and Monsieur Mateesco spoke on the subject of the incidental losses which in the aggregate did so much to lower the total efficiency. Frequently efficiency was lost largely by bad operation and maintenance, but there were also initial faults of design. He had, for instance, noted considerable losses owing to loss of head in the force pipes, and also in the screens. Deposits of gravel and sediment arising from badly-constructed headworks were also sources of hydraulic loss.

Mr. Patchell mentioned the extended use of the Diesel engine in British shipping, and referred to the exhaustive tests of five Diesel motor ships by the Institution of Mechanical Engineers. Not only was the thermal efficiency of such ships very high, but their manœuvring capabilities were excellent, which was a point to be considered in connection with navigation on the Swiss Lakes, where boats had to be started and stopped frequently. It was doubtful whether anyone in that room would live to see the end of the reciprocating engine.

Monsieur Legouez, referring to the question of inland navigation, said he was much surprised at the figures given for the economic towing speeds of barges. On the Rhine boats were towed economically on a river with a speed of current between Strasbourg and Basle often amounting to 3·50 m. per second, and the bar of Istein was crossed at speeds of 5 m. Speed presented one of those technical questions of which the solution depended on place and circumstance. There was in existence an International Conference of Inland Navigation, which would meet at Cairo in December. He proposed that the question of the limiting admissible speed for inland navigation should be referred to it.

Monsieur Fontaine said he had taken part in discussions on the economic speed in canals since 1923, when the International Navigation Congress was held in London. The Germans, unfortunately, were not represented there. The question came down to the difference between the German proposals of 70 c.m. per second, and the French figures for the Alsace canal—which was made as small as possible for economical reasons—of 1·20 m. per second. If one wanted to generate electricity by water power from canals, it was necessary at times of heavy load to admit a speed of about 1 m., or even 1 m. 20 cm. per second. It would seem that in general a figure of 70 to 80 c.m. per second would be about right. The question ought to be settled internationally in the interests of canal transport.

Monsieur de la Brosse pointed out that a speed of, say, 1 m. per second was not the same thing in a little canal as in a big one, nor in a straight canal as in one with curves. For that reason he hoped that the present Congress would abstain from putting forward figures which might be in absolute disaccord with the conclusions reached by the International Congress of Internal Navigation.

SECTION C.

This section covered The Economic Relation between Electrical Energy Produced Hydraulically and Electrical Energy Produced Thermally.

A general survey of the various reports submitted to it was presented by Dr. A. Nizzola, whose summary we reproduce in part below.

THE ECONOMIC RELATION BETWEEN HYDRO-ELECTRIC AND THERMO-ELECTRIC ENERGY.

By A. Nizzola, President of the Motor-Columbus Company, Baden.

Eight reports are dealt with, and the General Reporter reaches the following conclusions, amongst others, from them:—

A survey of the reports received and considerations arising from the study of them lead to the establishment of the following general guiding principles as being the main factors affecting the economic relations between thermal and hydraulic electric power production. Questions of secondary importance are not taken into account.

(1) A considerable difference between the two methods of power production arises from the entirely different apportionment of capital and expenditure. Water power stations generally involve a much larger outlay than thermal stations, but, on the other hand, thermal stations have very much higher actual running costs.

(2) Consequently the fixed charges on the production of energy in hydro-electric plants, such as interest, depreciation and liquidation of the plant cost, are of chief importance, while the increase of expenditure as a result of increasing load has practically no effect financially. In thermally operated power stations the exact reverse holds; excluding the circumstances in which the consumption time is very small indeed, the actual running costs easily exceed the fixed charges.

(3) When the possibility exists of employing either one or other method of power production—

(*a*) Hydro-electric production will appear uneconomic, and will be rejected, *if*, for all consumption times met with in practice, the energy costs more than with thermal production. Generally, however, this is not so, at least not in districts which have hydraulic power plants within reasonable distance, and the total cost of producing hydro-electric energy will be still more favourable as long as the consumption time keeps above a certain critical value. The power requirements of a district can always be divided into two parts, one with a consumption time greater than the critical value and the other less, and because of this, better economy is offered by combining the two methods of power production.

(*b*) On the other hand, thermal production will appear uneconomic and will therefore generally be rejected if water power is available in sufficient quantity and will allow under existing conditions consumption time and utilisation of cheaper energy production than with a thermally operated station. Such conditions seldom arise, usually only in a few areas possessing particularly favourable water power resources—see paragraph 5. In such circumstances thermal power only comes into consideration for reserve plant or when the necessity for limiting the outlay outweighs cheapness of operation.

(4) Thermally operated stations usually have the advantage of being able to conform readily to the immediate requirements. Hydro-electric plants, on the other hand, are dependent on a variable flow of water, the variations of which do not correspond to the variations in the energy requirements. It is sometimes economically possible to meet the requirements by storage or pumping, but such cases are very limited, and it would be quite impossible, for example, to apply such a method to the greater part of the Alpine hydro-electric stations to make them conform to the variations in power consumption.

(5) From the remarks in paragraph 4 it is obvious that the supply of any district exclusively with hydro-electric power leads generally to unavoidable losses, owing to surplus water running to waste. It is from this characteristic of hydro-electric stations that the great advantages generally occurring from a combination of the two methods of power production are made most evident. The greater the saving of otherwise lost water power brought about by such combination, the greater is the scope remaining for thermally produced power before its allowable limit of total cost is reached.

(6) When various hydraulic and thermal sources of energy are interconnected, the fitting of the production of each separate source into the load diagram usually follows fairly readily. An endeavour should be made to keep stations having a steady flow of water, or which are using waste heat, in continuous operation, *i.e.*, these should come first at the bottom of the load diagram; hydro-electric plants with day-to-day storage should similarly be kept in daily operation, but these will be used to cope with the peaks in the load diagram. Hydro-electric plants with year-to-year storage will be used to meet peak loads and also in the event of a water shortage. The degree of utilisation will be based on a previously arranged plan, but must conform at the same time to the climatic conditions. The remaining thermal power stations will be expected to make up for deficiencies in the load diagram; steam-operated stations operate more economically at constant load, and should therefore, if possible, be kept in operation both day and night; Diesel plants will be required to meet peak loads as they are particularly adapted to that purpose.

(7) Mention should be made of another matter with which several of the reports dealt, namely, the future possibilities of considerable technical and economic improvements in thermal power production. It may be taken for granted that the transformation from natural to electrical energy through the agency of thermal energy leaves far more room for increases in efficiency than does the transformation with water power, and also that the total costs of production, which are only indirectly dependent upon the efficiency, allow of much greater reductions with thermal plant than with hydraulic plant. In the utilisation of fuels there appear considerable prospects of being able to produce chemical products and electrical power simultaneously, and in addition to this, with modern methods of production of energy, to make use of the waste heat liberated. As opposed to this, water power does not present any obvious possibilities of reduction of total cost, with the exception of that held out by the progressive paying off of the initial plant cost. In the majority of countries also, a reduction of the interest on borrowed capital might have a favourable effect on hydro-electric power development.

At the first meeting of the section, held on Monday morning, September 6th, the chair was taken by Dr. John W. Lieb, who, in opening the discussion, said that the subject was not only one which affected the electrical industry, but one which was of paramount importance to the general public. It touched upon the most economical use of national resources. The Conference would go on record as recognising international obligations with reference to power, which overstepped national and political divisions and boundaries. The rivalry in the design both of hydraulic and steam plants had engaged the highest engineering talent, and the world seemed to be on the threshold of great advances. The co-ordination of the two sources of energy at a minimum of total cost seemed to imply generally the provision of a thermal plant not of the highest possible efficiency, but one which would be low in capital cost, instantly available for service and of large overload capacity. In such plants, owing to the small number of hours per annum during which they would be in operation, efficiency was a small matter in comparison with the other qualities mentioned.

Monsieur Nizzola, the General Reporter of the section, said the question of the combination of thermal and hydraulic power stations was not new, for as early as 1890, when large hydro plants were first constructed, it was common to see them combined directly with steam plants on account of the inconstancy of the hydraulic power. Little by little, however, the steam plant lost its importance, at least in countries like Switzerland, rich in water power, because its function of equalisation and reserve was fulfilled more and more by systems of water accumulation. Recent improvements in thermal plant, especially in the cost and efficiency of large units, had, however, made it likely that steam plants would recover their importance. The report of Monsieur Prikril related to conditions in the North of Jugoslavia. There, on the river Drave, was the very important Fala power plant. A new power plant was about to be constructed at Krisk, on the Save. These two rivers had a very different yearly flow, so that the two power-houses tended to supplement each other. Between them were the Trifail coal mines. This created a situation wonderfully favourable for a combination of hydro and steam power. Then there was the report of Monsieur Hofbauer, which considered the possible solutions of the question in a region like Styria, very rich in water power and also very rich in fuel. Furthermore, there were in that region many industries capable of using waste heat, for example, the iron and paper industries.

Dr. Enstrom pointed out that at the end of the report there was a summary, but no conclusion. He had collected data from Swedish plants working with steam and hydro-electric power, and had tried to give some data of actual operating costs. He had, however, found it impossible to draw any general conclusions. It seemed, as the General Reporter had found, that the only useful thing to do was to examine the co-operation between steam and hydro plants with reference to the conditions of each particular case. Speaking of the Ruths accumulator, Dr. Enstrom said he was familiar with two plants, one in which the accumulator worked in conjunction with a steam turbine, and was able to take the load for a short time when a transmission line was cut out. The other case was that of a works buying hydro-electric power, but using steam for heating purposes. By the use of the accumulator the maximum demand on the hydro system could be limited to a value which enabled an advantageous price to be paid for current. In both these cases the accumulator came into action smoothly and satisfactorily.

Mr. Rushmore said that in Mr. Mitchell's paper the Alabama Power Company had been considered and an endeavour made to deduce a general principle with regard to the development of steam and hydraulic plants. The conclusion arrived at was that it was best to over-develop the latter and to supplement them where necessary by steam plants. The attempt to derive exact mathematical formulæ for matters in which the data were uncertain was noteworthy, and was an example of the scientific motive to reduce all things to general principles.

The Chairman said that in the papers under consideration there was little, if any, reference to the importance or, he would rather say, the absolute necessity of having a thermal plant ready for instant operation in the event of a failure of a transmission line, or of any element of a hydro-electric plant. If, in the United States, it was attempted to supply centres such as Chicago, New York, Boston, or Philadelphia from any transmission line, serious difficulties were likely to be encountered. In New York, where the conditions were perfectly familiar to the speaker, it would be commercially impracticable and financially impossible to give the service demanded from any transmission line coming from outside territory. If New York took hydro-electric power from Niagara or the St. Lawrence River it would be an absolute necessity to keep the steam plants in the city in continuous operation, so that they might be available to meet any interruption, however short. A failure of electric supply, even for a short time, was a disaster of the first magnitude. The extinction of fires was dependent upon a continuous electric service, for a large part of the city was practically without fire-engines. Furthermore, more passengers were carried in the elevators in one day than on all the traction lines of the city. Over twice as many passengers were carried vertically per day as were carried horizontally. The Chairman then referred to the system of interconnection of large power stations in the United States, where inter-

connecting lines extended up to 1000 or 1500 miles, these lines being, of course, fed at intermediate points. In such cases it was absolutely necessary to have a system operator or load dispatcher, who controlled the whole system, stations being shut down, started up, or load shifted from one to another under his orders.

M. Devun said that in the undertakings of the Compagnie Electrique de la Loire et du Centre, with which he was connected, it was often found necessary to combine hydraulic and steam power, all the available water being used during the hours of heavy load. The lighting peak, by a happy chance, occurred after the power load was over, a fact which allowed the daily water storage to be almost exhausted by the power load. There were months in the year when the hydraulic powers of the Alps as well as those elsewhere were very short. That occurred during the coldest months, January and February. It was therefore necessary to have steam power to assure a regular service. Fortunately, the company was able to install at St. Etienne, the principal town of its area and one with coal mines, a thermal station. Thus the condition for continuous service was easily secured. The conclusion of the company was that the development of a new district demanded the installation of steam stations, and that creation of steam stations brought about the construction of hydro-electric plants when the hour arrived and the expenditure was justified.

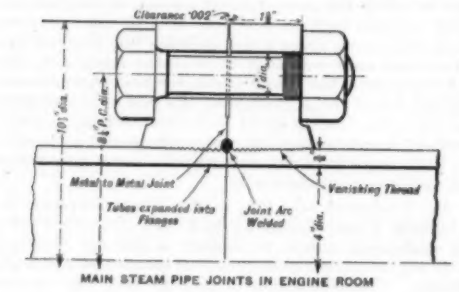
Dr. Quack considered that interruptions of supply could be avoided by the interconnection of hydro-electric stations. He did not like steam stations and thought that a proposal which had been made to find work for the unemployed in the construction of steam stations was unsound. They would be much better employed in building hydro-electric stations.

The High-pressure Turbine Steamer King George V.

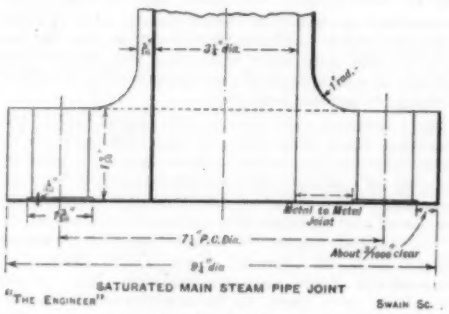
No. III (*Conclusion*).*

Pipe Lines, Valves, and Salt Detectors.

The success which has attended the high-pressure installation of boilers and geared turbine machinery in the Clyde turbine steamer King George V. is to be attributed not alone to the careful design of the main engines and boilers, but also to the care and thought which has been expended on such essential details as steam pipe lines and pipe joints, safety valves and regulating valves, and other auxiliary devices which have been specially adapted for the very high steam pressure of 500 lb. to 575 lb. per square inch, with a total superheated steam temperature of 750 deg. Fah.



MAIN STEAM PIPE JOINTS IN ENGINE ROOM



SATURATED MAIN STEAM PIPE JOINT

"THE ENGINEER" SWAIN Sc.

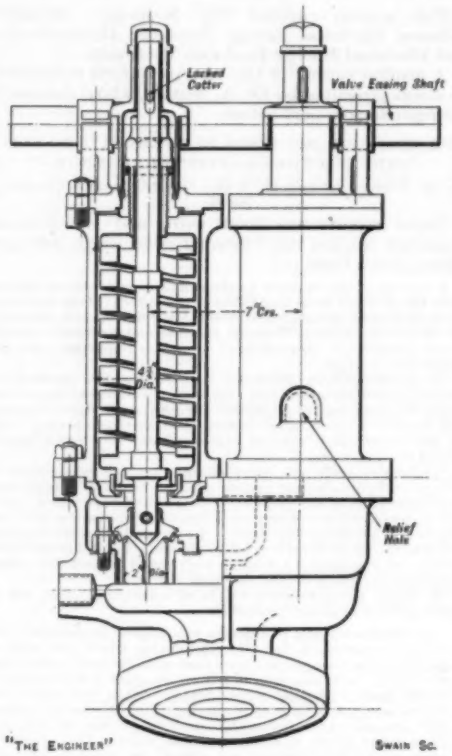
STEAM PIPE JOINTS

In the present article, reference will be made to a few of the more interesting of these details.

Main Steam Pipes.

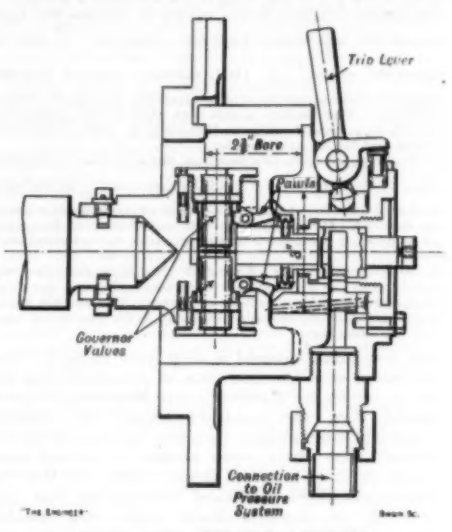
In the illustration above we give to-day a dimensioned drawing of the main high-pressure steam pipe in the engine-room. This steam pipe, which runs from the self-closing emergency stop valve on the forward bulkhead to the ahead regulating valve and the high-pressure turbine, is 4in. in diameter, and the diameter of the valve passages in the valves mentioned is 4¼in. All the pipes which compose this main—unlike the boiler pipes which as described below are bored from the solid—are made of solid drawn steel tubing, which, before its installation in the ship, was tested to three times the working pressure it is called upon to withstand. As shown by the drawing, the flanges, which have a diameter of 10½in. and a thickness of 1⅛in., are screwed on to the ends of the pipes with a vanishing thread. After being screwed into position the ends of the pipes are expanded into the flanges. The end of the pipe thread at the flange face is then sealed off by arc welding. It will be seen that a metal-to-metal joint is made at that part of the flange which is within the bolt circle. The metal on the face of the flange immediately in the vicinity of the bolts is relieved so that the full effect of the tightening of the bolts is obtained at the metal-to-metal joint. A clearance of about two-thousandths of an inch is provided between the inside faces of the two flanges near the periphery, such a provision rendering any bending of the flange at once noticeable. Eight 1in. bolts arranged on an 8½in. pitch circle are used. As illustrated in our last article, any thrust in the main steam range which might be caused by expansion is counteracted by the free use of expansion bends. Between the emergency valve on the forward bulkhead and the ahead regulating valve there are two expansion bends, whilst three others are included in the steam main from the ahead regulating valve to the high-pressure turbine.

Details of one of the boiler steam pipes, namely, the 3½in. full-pressure saturated steam pipe between the steam drum and the superheater drum are also given in our first illustration. In this instance, as also in that of the main boiler steam pipes, the pipe, together with its flanges, is machined from a solid steel forging. The flanges are 9½in. in diameter, and provision is made for eight 1in. bolts on a 7½in. pitch circle. It will be seen that the wall of the pipe is only $^{5}/_{16}$in. in thickness, and an easy radius carries the wall into the $1^{7}/_{16}$in. thickness of the flange. The joint is, again, metal-to-metal, and in design it is substantially the same as that which we described for the main steam pipe line.



"THE ENGINEER" SWAIN Sc.

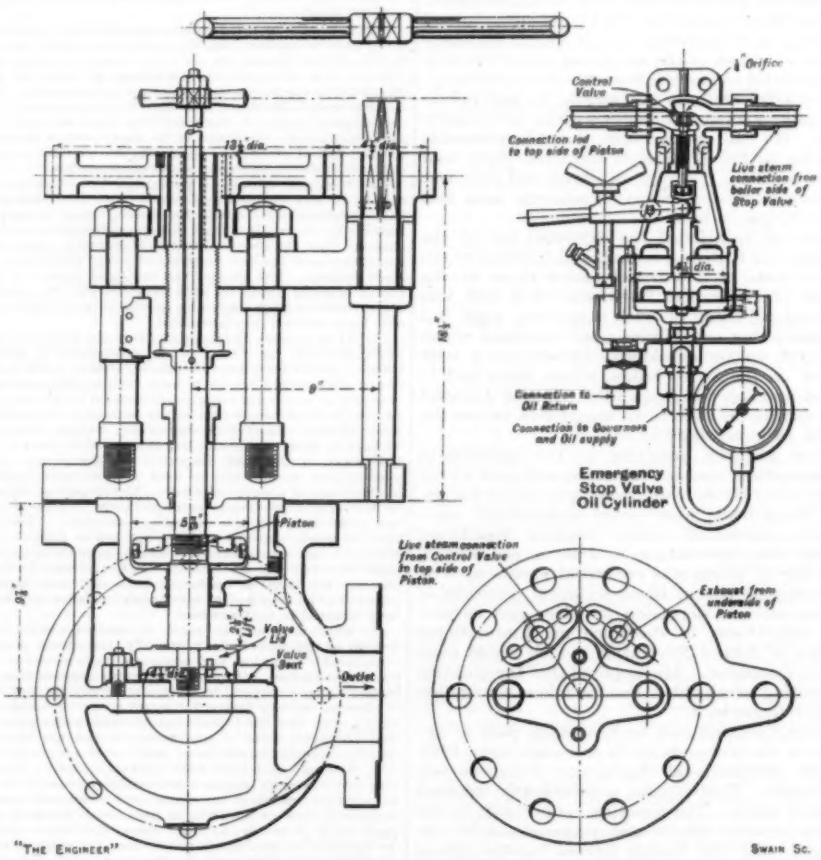
COCKBURN HIGH-LIFT SAFETY VALVE



CENTRIFUGAL TURBINE GOVERNOR

Boiler Safety Valves.

One of the most important valves in the installation is the boiler safety valve, a drawing of which is given herewith. The ordinary type of safety valve, with a small lift, is generally recognised to be a trap for grit, &c., when the valve is blowing off. If the valve should close down on such grit, indentations are made in the seat, and with the escape of high-velocity steam, grooves are soon cut. For this reason the boilermakers preferred to fit the high-lift type of safety valves, which is manufactured by Cockburns, Ltd., of Cardonald, Glasgow, under the Cock-

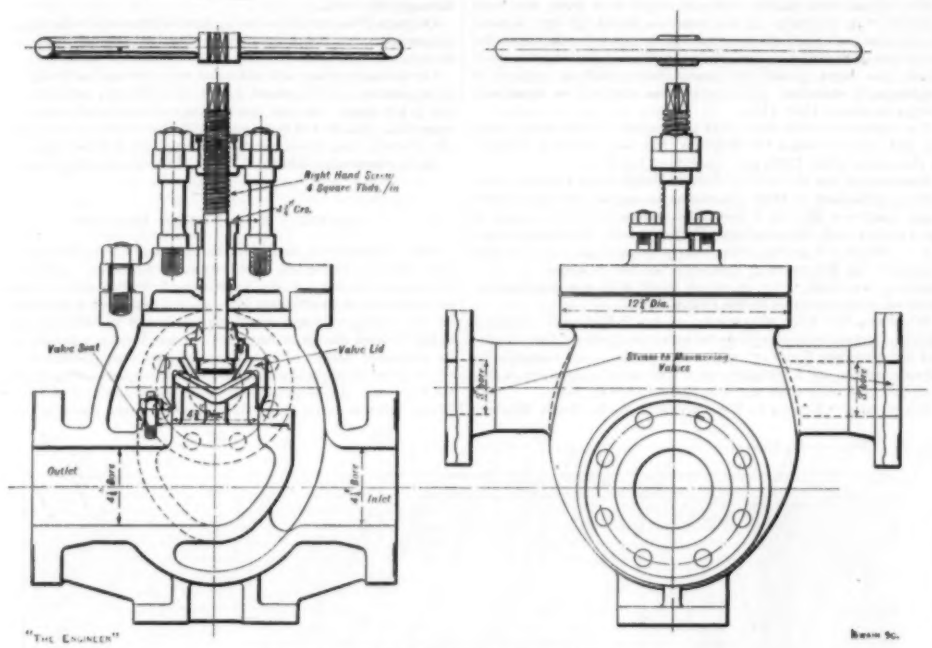


"THE ENGINEER" SWAIN Sc.

COCKBURN SELF-CLOSING STOP VALVE WITH OIL RELAY

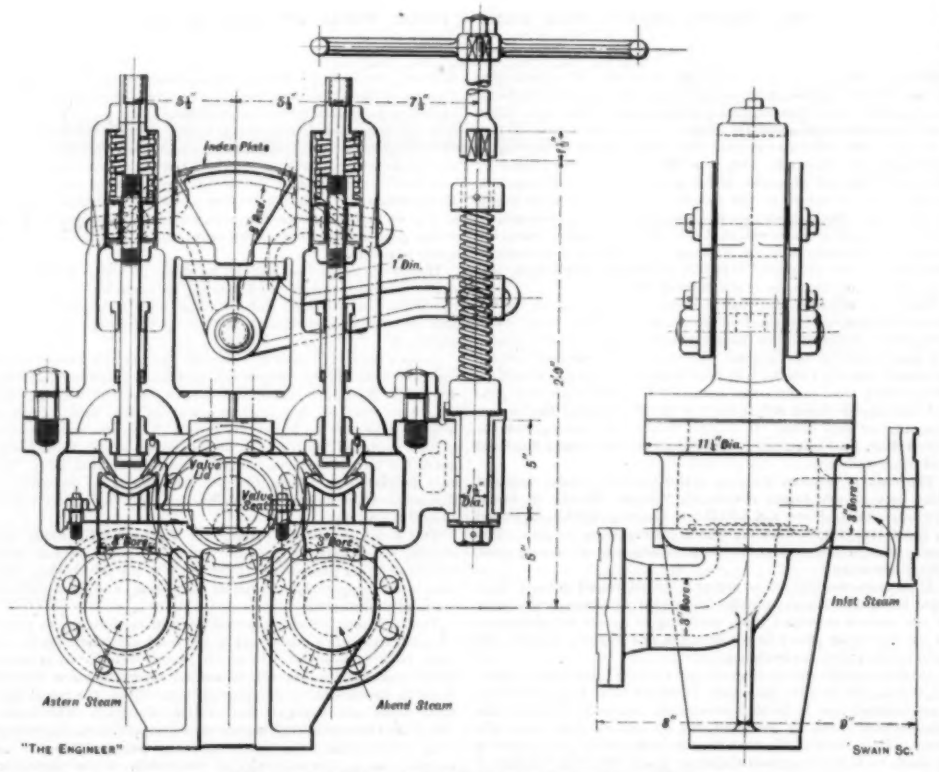
* No. II. appeared September 17th.

burn-MacNicoll patents. The outstanding feature of the improved high-lift safety valve which we illustrate is that it has double the discharge capacity of an ordinary safety valve having the same diameter, and that consequently it is accepted by the Board of Trade and the classification societies at half the area given by their standard safety valve formulæ. The increased discharging capacity of the valve is obtained by utilising the pressure of the waste steam—or



COCKBURN BALANCED AHEAD REGULATING VALVE

"back pressure"—to act on a piston which is arranged at the bottom of the valve casing, and so to increase the lift of the safety valve proper. A further advantage of this type of valve is that the diameter of the waste steam pipe need only be half the area usually required. The valve chest with the connecting flange, the two valve-seat housings, and the central discharge passage behind the valves, is, like the casing and the casing cover with its casing shaft brackets, made of cast steel. Stainless steel is employed for the lids and spindles of the safety valves, which rest on a nickel alloy seating. The piston above the valve proper is also made of nickel alloy. In each valve casing there is a nine-coil spring, 10in. in length, which is compressed to about 9¾in., and when set is fastened by a padlocked cotter passing through the top part of the spindle. From the drawing given it will be seen that the top of the valve spindle above the spring passes through a gun-metal guiding bush, which provides an additional safeguard against the spindle jamming. A relief hole is cast in the wall of the casing as shown. The casing shaft is provided with solid forged fork pieces, which project under the cap and serve to lift the valve. As the safety valve we have described is mounted on the end of the superheater drum, a rod attached to a lever on the casing shaft is brought down to a convenient level above the stokehold floor, and is fitted with a hand wheel and screw operating arrangement. Each of the two 2in. high-lift double spring boiler safety valves is designed for a working pressure of 575 lb. per square inch, and a test pressure of 1150 lb. Each valve is capable of dealing with a total evaporation of 20,000 lb. of steam per hour, at a total steam temperature of 750 deg. Fah.



COCKBURN AHEAD AND ASTERN MANŒUVRING VALVE

THE EMERGENCY STOP VALVE AND TURBINE CONTROL GOVERNORS.

On the bulkhead at the forward end of the engine-room is mounted a Cockburn-MacNicoll self-closing stop valve which is fitted with an improved emergency shut-off. This cut-off may, in case of need, be hand operated, but ordinarily is automatically worked by the Aspinall centrifugal speed control governors which are fitted to all the turbines except the first intermediate-pressure turbine on the port side of the ship, the shaft of which, being in tandem with the high-pressure turbine, is fully protected by the governor fitted to that turbine. The essential principle upon which the self-closing valve works is that of by-passing steam from the boiler side of the main stop valve to the top side of a piston arranged in the valve casing, which in turn closes the main valve. The automatic control from the governors on the six turbine shafts is obtained through the medium of the lubricating oil pressure in the turbine systems. The governor illustrated is that which is fitted to the high-pressure and intermediate-pressure turbines. The design has been developed jointly by Messrs. Aspinalls and Cockburns, Ltd. It consists of two hollow valves or plungers whose ends abut each other. These plungers are carried in a casting mounted on the end of the turbine shaft. Hence they tend to fly apart by centrifugal force, but are restrained by springs. Whilst their two end faces are in contact no oil can pass, but once they are separated the oil finds an exit through their hollow centres. They can be so adjusted as to allow, at normal speed, a rate of leakage which is supplied by the oil pumps. If, however, they are separated by a greater amount the leak increases, the pressure in the oil supply falls, and the oil relay on the control valve permits that valve to open, thus causing the closing of the main valve. The plungers are spring loaded and they are set to govern between the speed range of 5 per cent. to 10 per cent. above the normal speed of 6000 revolutions per minute for the high-pressure and intermediate-pressure tubines and 3000 revolutions for the low-pressure turbines. Up to increases of 10 per cent. above these speeds the governor valves move in and out and effect a steam control through the medium of the lubricating oil pressure in the oil control cylinder for the main valve. Between a 10 per cent. and 20 per cent. increase over the normal running speed the governor emergency pawls engage the plungers and lock them out, causing the supply of steam to be cut off by exhausting the oil lubrication pressure usually present in the oil operating cylinder, and so allowing boiler steam to pass to the piston on the top of the stop valve and so to close it. The arrangement described and illustrated thus provides a means of hand control in the case of an emergency on the main valve, the oil operating cylinder, and each governor, as well as speed governing between fixed limits and an automatic shut-off in the case of the excessive speed of any one turbine as might arise by a shaft breaking. It also gives protection against a failure of pressure in the forced lubrication system, which would also cause the shut-down valve to be operated. As shown, the main valve is geared and it is worked by an 18in. diameter hand wheel.

REGULATING, MANŒUVRING AND SILENT BLOW-DOWN VALVES.

The single-beat balanced type of ahead regulating valve for full power is made with a cast steel casing which is provided with 4½in. diameter inlet and outlet passages and also two 3in. connections, which deliver steam to the manœuvring valves. The lid and seat of the valve and the spindle are made of stainless steel, while the neck rings and bushes are of nickel alloy. As the valve is balanced, no gearing is required, and it is operated by a 20in. diameter hand wheel, an extension spindle 2ft. in length being fitted to give a suitable height at the starting platform. At either side of the main ahead regulating valve are the hand wheels for the 3in. ahead and astern positively controlled manœuvring valves. The feature of this type of patented valve is that both the ahead and astern valves are positively controlled by link gear through one hand wheel, as shown in the accompanying illustration. The valves are of the single-beat balanced type with cast steel casings and stainless steel valve lids, seatings and spindles. As in the ahead regulating valve, nickel alloy neck rings and bushes are employed. With a few turns of the manœuvring valve hand wheel the steaming conditions can be reversed from full ahead to full astern, or *vice versâ*, in a few seconds. Although all these valves are built to withstand the full working pressure and temperature of the steam, the actual operations are carried out with 200 lb. pressure steam, nozzles being fitted in the manœuvring steam pipes to reduce the full pressure to that figure.

Two other valves which form an integral part of the control arrangements are those for the silent blow-down connections to the condensers. They are accommodated in a special cast steel valve chest which is fitted in the main pipe line immediately before the ahead regulating valve. The valves, of which there are two, one at either end of the chest, set at 17½in. centres, are 1½in. in diameter and are operated by 8in. hand wheels on extended spindles. These valves are designed for the full working pressure and temperature and have special stainless steel and nickel alloy fittings. The blow-down pipes to the condensers are of a small diameter, and special baffles are fitted in the condensers to distribute the steam without danger to the condenser tube packings. All the valves described were supplied by Cockburns, Ltd., and built under the Cockburn-MacNicoll patents.

SALT DETECTORS.

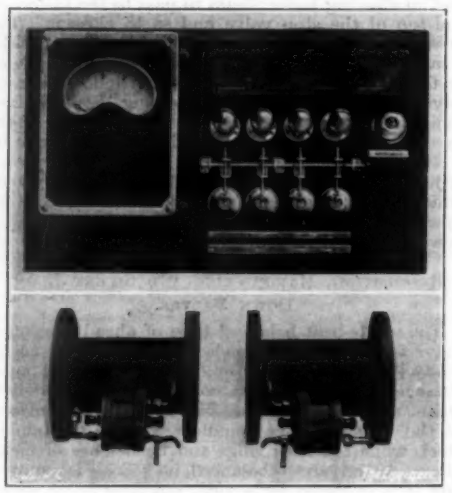
In order to ensure at all times that the feed water which is delivered to the water-tube boilers, is entirely free of salt, a very complete apparatus for the detection of salt has been installed. It is illustrated herewith, and was supplied by William Crockatt and Sons,

Ltd., of Glasgow, the patentees and makers of the Simplex salt detector. The installation on the King George comprises a multipoint instrument for the air pump suction lines and a special detector unit for the feed pump discharge line. In the engraving reproduced below, the instrument board of the multipoint detector at the starting platform is shown, along with two of the four castings with the electrode cells attached, which are fitted into the four air pump suctions. In each pipe a small diverting scoop is fitted, so that a continuous stream of the condensate passes through the electrode cell. From each of the cells twin wiring is run to the instrument board already referred to.

The board itself is furnished with four switches, immediately above which there are placed the four indicating lamps, which are of a suitable resistance to work in connection with the ship's lighting circuit.

Should salt be present in the condensate from any one of the condensers, then the corresponding lamp will begin to glow, and the engineer on watch will then switch that cell into circuit with the 6in. dial salinity indicator, to be seen to the left of our illustration, which is calibrated to read in units from 0 to 5 grains of salt per gallon. From the reading thus obtained, it may be judged whether the contamination is of such an amount as to justify immediate attention and the closing of the condenser flap valves. As it is essential that only one cell should be coupled in the circuit of the indicator at any time, a sliding locking lever is fitted above the switches, so that no other cell can be switched into circuit until the first switch to be operated has been replaced in its original off position. The arrangement also ensures that at all times all the cells are continuously in circuit, either with the indicating lamps or with the salinity indicator itself.

At the top of the board there is a series of relays,



CROCKATT'S SALT DETECTOR

which are designed to operate in such a manner that should a sudden influx of salt water take place, a bell on the salinity indicator will begin to ring and will continue to ring until the degree of salinity is reduced to a predetermined amount. There is a master switch placed to the right of the instrument board, which controls the entire electric circuit.

In addition to the apparatus we have described, the same firm supplied a self-contained salt detector unit, which is fitted in the feed pump discharge line, and placed on the forward bulkhead at the turbine level. Like the other instrument, it is calibrated to read in units of 0 to 5 grains of salt per gallon. The water is supplied to the apparatus by a small by-pass valve fitted in the feed pump discharge line, terminating in a copper pipe, which is led to a funnel placed just above the salt detector. The valve is opened just sufficiently to ensure a continuous flow of feed water through the electrode cell, which is placed within the case of the indicator. The warning lamp and the indicator are in continuous operation, and the water from the cell is led back to the feed tank. It will thus be seen that should any leakage of salt water take place in the condensers, it will be at once detected by the multipoint outfit, whilst any contamination of the water in the feed tank immediately before passing to the boilers is shown by that detector which is installed in the feed discharge line. The detectors are simple in design and require, we understand, very little attention, as there are practically no working parts. Current for working the apparatus is supplied from the ship's lighting mains, and the amount of current which is required or the complete installation of cells and detectors does not exceed in amount, we are informed, that which is taken by an ordinary 60-watt lamp.

In this article we have mentioned but a few of the many interesting details of this pioneer installation of high-pressure marine turbine machinery. There is little doubt in our minds that the King George, like the King Edward of twenty-five years ago, built for the same owners, will influence widely the future of marine boiler and steam turbine design and practice.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

"A CENTURY OF LOCOMOTIVE BUILDING BY ROBERT STEPHENSON AND CO.": SOME CORRECTIONS AND NOTES.

SIR,—Presuming on the welcome which you gave my book entitled "A Century of Locomotive Building by Robert Stephenson and Co." on its appearance, may I ask space for correction in regard to a notable locomotive, "Harvey Combe," which has been quoted for many years past as typical of Stephenson's standard patent engine as supplied to home and foreign railways, 1834–1840.

The makers records state that the engine of this name, their No. 123, was intended for Belgium, but was supplied instead, on December 28th, 1835, to "Cubitt, of London."

Marshall, in his account of Robert Stephenson's patent locomotive, published in 1838, illustrates an engine which he states "was made for Messrs. Cubitt, the contractors for a part of the London and Birmingham Railway near Berkhampstead. · · · When the works were nearly completed · · · it was purchased by the railway company for the purpose of · · · repairing the road · · · in which work it is now employed." Marshall gives no name to the engine.

Whishaw, not long afterwards, in his "Railways of Great Britain," gives the Harvey Combe as on the books of the London and Birmingham Railway, where it was the more remarkable, indeed unique, as a Stephenson six-wheeled engine on a line equipped generally with four-wheeled engines by Bury.

Wood, in a "Report to the Directors of the Great Western Railway," December 10th, 1838, gives results of experiments on the Harvey Combe of the London and Birmingham Railway, to compare with contemporary experiments with the North Star of the Great Western Railway.

In the face of all this evidence the identification of the engine illustrated by Marshall, with the Harvey Combe, listed by Whishaw, seemed absolute, although the various descriptions do not agree in regard to the number of tubes and some minor dimensions. Such discrepancies are, however, so common in early records of locomotives, that they did not seem to outweigh the case for identity, and the drawings from Marshall were therefore reproduced on pages 318, 319, of Robert Stephenson and Co.'s Centenary Book as of the Harvey Combe.

But when engaged last year in collecting information for the reconstruction, at Swindon, of Stephenson's North Star, 1837, I was led to doubt whether the single-lever, four-excentric reversing gear fitted to this engine, and shown by Marshall for the supposed Harvey Combe, had been fitted so early as December, 1835, when that engine was completed. This improved gear does not appear much before 1837–8 on such original Stephenson drawings as still exist. It is then found on drawings for the North Star, La Victorieuse, and engines for the Grand Junction and other railways.

The makers original drawing of the Harvey Combe does not exist, but I have found in Simm's "Public Works of Great Britain," 1838. Plate LXXVIII., a drawing definitely stated to be of the Harvey Combe, which confirms my doubts. The engine shown has a *four-Kandle loose-excentric* reversing gear. (See illustration.)

It appears therefore that either :—(*a*) Marshall did not illustrate the actual Harvey Combe, but a later and improved engine of the makers standard type, omitting to notice the difference in the reversing gear ; or (*b*) by 1838 the Harvey Combe had been refitted with the improved gear.

Until this point can be cleared up the name "Harvey Combe" applied to the engine shown by Marshall is at least doubtful. I am inclined now to think it is actually incorrect, and that the engines illustrated by Marshall and by Simms were never the same. It is remarkable that Bourne's sketch of a locomotive at work in Berkhampstead Cutting—page 326, "A Century of Locomotive Building"—shows the dome behind the chimney as Simms does. Marshall shows it on the fire-box. Bourne was an accurate draughtsman, and his evidence helps to point to two distinct engines.

Before leaving the subject of the "Harvey Combe," I would ask whether any of your readers having local knowledge can trace a connection with some place name near Berkhampstead, or can suggest any other source for the name. Place names for locomotives were unusual at that time.

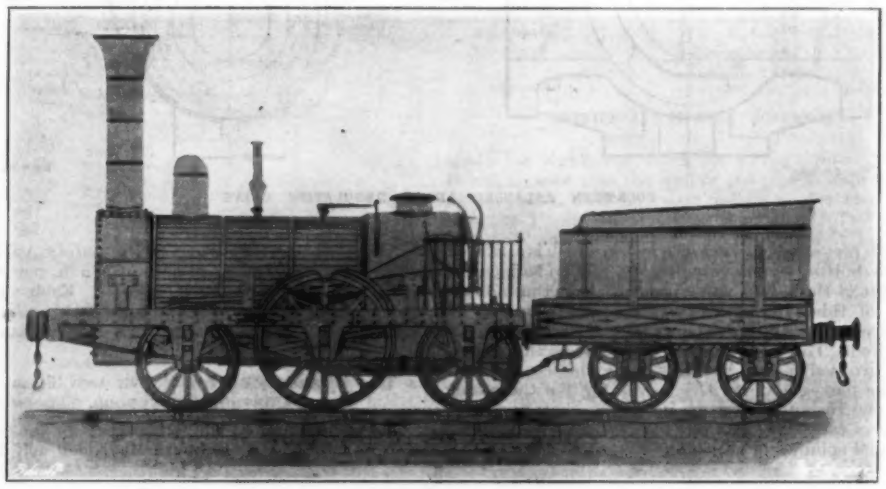
May I add in regard to other special engines and types described in "A Century of Locomotive Building," that subsequent discoveries have generally confirmed or amplified the conclusions arrived at. M. Ferdinand Achard has found valuable information on the first locomotives sent to France, and on those of the Stockton and Darlington Railway—to which he has already alluded in a letter to THE ENGINEER—and an early woodcut has been found showing one of the first four engines of that railway as at work in 1829, being the earliest yet known.*

A number of original letters from Robert Stephenson give important information on the activities and interests of himself and his father, and prove that the piston valves shown on page 285 of "A Century of Locomotive Building" were actually fitted to one of the "Atlas" type of the Liverpool and Manchester Railway. It is shown too that Robert Stephenson had at the same time a design for a balanced slide-valve exhausting through the back.

On page 320 a correction is required in reference to Stephenson's locomotives in Belgium—Albert Simons should read Pierre Simons.

On the same page a doubt must be expressed as to the wheel arrangement of L'Eléphant, given, on a Belgian authority, as of the 2–4–0 type. It was more likely of the 0–4–2 type, as on page 315. The 2–4–0 type, page 324, was probably not adopted till after the date given for the construction of L'Eléphant.

Bath, September 22nd. J. G. H. WARREN.



THE "HARVEY COMBE" FROM SIMM'S "PUBLIC WORKS OF GREAT BRITAIN"

BRONZE WORM GEAR BLANKS.

SIR,—*Apropos* of Mr. F. W. Rowe's paper on "Bronze Worm Gear Blanks Produced by Centrifugal Casting," presented at the Liége meeting of the Institute of Metals and referred to in your issue of September 17th, may I make a few observations on the casting of worm wheel blanks, based on modern methods in the United States of America. It has been my privilege over an extended period of years to cast and cut perhaps as many worm gears as anybody else, and it is always a matter of interest to note the development of this particularly difficult gear. Many failures have from time to time been made in various quarters, owing to a lack of proper consideration of the variables that enter into the development of a gear wherein the peculiar propensities of the helix are inherent.

It is immediately clear that the thoughtful person will endeavour to eliminate to the utmost extent the sliding action, and approach as nearly as possible a rolling condition, and much has been accomplished in this respect during recent years. Extraordinarily high efficiencies have been obtained, and so to-day we find that, ratio for ratio, a well-designed and well-made worm gear set compares very favourably with other available speed reducers.

However, much has had to be done in order to reach the present high standard, and having to consider a semi-sliding condition not the least difficulty has been in obtaining a suitable gear bronze wherewith the lowest coefficient of friction is obtained.

Copper tin alloys have in a general way always seemed to offer the best anti-friction properties, and most generally have been adopted. A copper-aluminium bronze, essentially 90 per cent. Cu, 10 per cent. Al, has in some instances been used. From the writer's experience a higher coefficient of friction seems inherent in this material, and whilst he has made many thousands of gears for one prominent manufacturer from this alloy, he is only partial to it where ultimate strength is an essential. In this respect the copper-aluminium-bronze is far superior to the copper-tin alloys.

This point of ultimate strength is of considerable value under certain conditions at present found by some motor manufacturers under present-day tendencies to lower vehicles. Road wheels are frequently of smaller diameters, and road clearance must be maintained.

The high unit pressures permissible in modern worm gearing have led to smaller gears, and so the road clearance has in some cases been maintained. In so far as the differential is usually fitted inside the worm wheel, and as a certain inner diameter must be maintained to accomplish this object, the result has in some cases been a rather frail wall to the gear. The value of aluminium bronze in such instances, with its high tensile strength, must be obvious. As, however, many people have not been satisfied as to the anti-friction properties of the aluminium-bronzes, the result has been many experiments to improve the ultimate strength of copper-tin bronzes, the anti-friction values of which are universally recognised.

Chilling, first by ring chills, and later by complete dies, and also centrifugal castings, have been tried.

Centrifugal castings have been made under varying pressures, and whilst the writer has not found the pressure to be used at all critical, excellent results have been obtained by this method. Die castings have also produced very excellent results when properly made. The size of the chills, the pouring temperature,

* This woodcut is reproduced with notes in the current issue of your contemporary, *The Locomotive*.

and a suitable coating for the dies have all been points to be deeply considered. Providing the chilling effect is sufficient to drive completely through the section of the casting without tapering off towards the centre, the ideal condition in this process is obtained, and micro-photographs and physical tests will exhibit a very excellent gear, comparing favourably with anything the subscriber has seen from the centrifugal process.

In centrifugal castings one must guard carefully against a tendency for the metal to freeze in layers, like a spiral spring or lathe scroll, and further the centrifugal effect has a tendency towards erosion of the inner refractory core. This remark in particular applies to a gear of which the inner periphery is not an unbroken circle, but is fitted with lugs, &c., for purposes of attaching the differential. Again, the centrifugal effect throws the heavier material to the outside and the dirt to the inside periphery. This, in itself, is an excellent condition, as it does ensure the best and cleanest material where the load-carrying teeth are to be cut; but frequently it has proved difficult to obtain risers capable of carrying off the dirt from the inner periphery, and not always has the casting been particularly clean in this respect.

It has, therefore, seemed to be the consensus of opinion of American manufacturers that no appreciable difference in ultimate strength has been obtained between centrifugal and semi-permanent mould castings, so that the semi-permanent mould type has been practically universally adopted, as offering an extremely uniform and high-grade material, whilst presenting the minimum of complications and expense as very little is necessary in the way of permanent equipment, as compared with the costly rigging necessary to obtain suitable machinery for whirling the castings under the centrifugal process.

The most favoured alloy in the United States to-day is essentially as follows:—Tin, 11 per cent.; lead, ·25; phosphorus, ·25; balance, copper. This is the S.A.E. specification No. 65, and by the semi-permanent mould process the following physical properties are being regularly obtained in volume production by at least three manufacturers:—Ultimate tensile, 20–23 tons; yield point, 13–15 tons; elongation, 6–10 per cent.; Brinell hardness, 500 kilos., 90–120. Some development has been made in the introduction of nickel in small quantities further to improve the ultimate strength, and one prominent manufacturer allows the foundries to use their own discretion regarding its use up to a certain point.

One manufacturer has its gear blanks supplied with the teeth rough cast in, but this complicates matters in the foundry, entails additional cost of the casting, and, again, means that the gear cutter must waste some time in picking up the tooth. Criticism has been raised sometimes by a tendency for hobs to ride at times and follow the excentricity of the casting, resulting in a gear "out of round," so that for the moment casting in the teeth has not found too many supporters, especially as a good market is available for such high-grade bronze chippings.

September 20th. C. J. FITZPATRICK.

DIESEL PNEUMATIC DRIVE FOR SHIPS.

SIR,—The Diesel engine has the great disadvantage of not being elastic enough for marine purposes. Hence the electric and hydraulic transmissions. It is true that very many ships have the direct drive and are quite easily started and reversed. Yet this is only achieved because other agents have been introduced, such as compressed air.

The Diesel is also a great waster of power, in the shape of heat. I don't know if anyone has ever thought about using the waste gases; in any case, they are allowed to go to waste.

The old steam engine has many virtues. It is fairly foolproof, is cheap, and it is easily worked and kept up. Moreover, it will work when quite out of adjustment. The Diesel requires careful *tuning* and special men to do it. But the steam engine is a bit of a waster, too, and the boilers take up a large space.

I propose the combination of the Diesel and the steam engine. In other words, I would introduce the pneumatic drive, at the same time eliminating some of the faults of both engines, and retaining most of their respective qualities.

In the pneumatic drive the Diesel—or several—drives an air compressor, and the compressed air takes the place of steam and drives the steam engine.

So far we have not simplified matters much. But let us not forget that an air compressing plant is already part of the Diesel engine.

The exhaust gases are now used to heat the air before it enters the high-pressure cylinder. It is here that the saving would come in. By using suitable reheaters, made somewhat like a condenser, almost all the heat of the gases will be used.

I cannot enter into many details within the compass of a letter, but the technical man will see at once the possibilities of the scheme. The "direct drive" advocate will, of course, turn it down at once, like he turns down the electric drive and other methods. Yet the system is well worth trying. The first cost will compare well with the cost of any other combination. If after that we can use the waste gases instead of allowing them to heat flues and funnels, there will be a saving of heat—or power, or money—well worth considering. RICHARD JANMART.

London, September 10th.

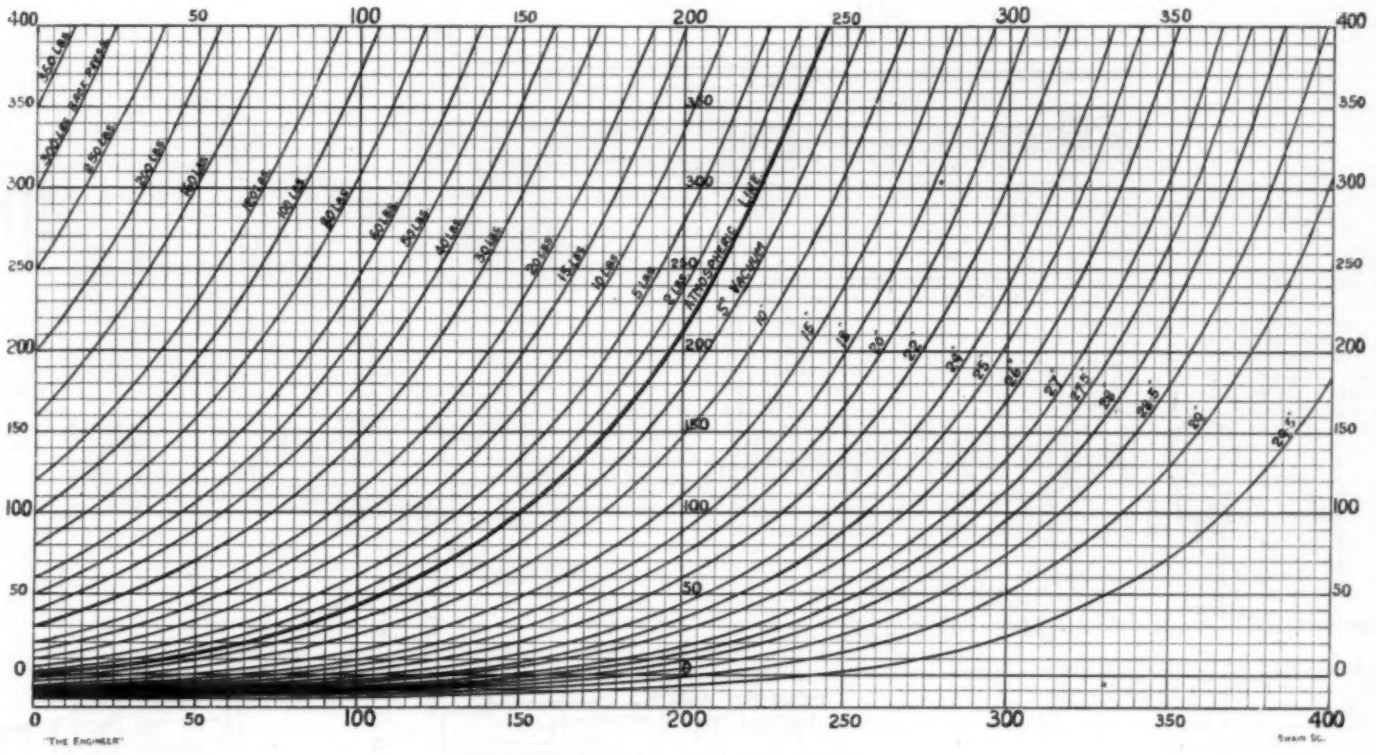
A NEW STEAM CHART.

SIR,—In view of the closing remarks in your article in THE ENGINEER for August 27th, on "A New Steam Chart, allow me to submit a copy of a form of direct-reading heat-drop chart which I have used for several years and have recently revised to conform with Professor Callendar's valuable tables. From a vertical scale of gauge pressures a direct reading is taken horizontally on the chart to any back pressure or vacuum curve desired.

The chart is made out only for saturated conditions, and calculations of consumption made on this basis, while for superheated conditions the total heat drop may be increased by a percentage or the consumption per horse-power reduced in accordance with usual allowances.

For those engaged in estimating this chart has proved invaluable, especially in considering back pressure problems. The freedom from lines indicating volumes and other properties prevents confusion and errors, while these can, if required, be readily obtained from tables or reference to the complete "Mollier" or other charts.

Colchester, September 1st. CHARLES BARNES.



DIRECT-READING HEAT-DROP CHART

TESTING FULL-SIZED STRUCTURAL MEMBERS TO DESTRUCTION.

SIR,—(1) On page 115 of the July 30th, 1926, issue of THE ENGINEER in your description of the 1250-ton testing machine at Birmingham, you state: "From time to time efforts have been made in America to test to destruction full-sized members of bridges and other structures, with the object of verifying the designers' calculations; but, so far as we are aware, the apparatus used in these tests was rather crude, and neither allowed of a graduated load nor of a precise determination of its magnitude."

(2) We believe this statement is apt to be misleading to many British engineers. At the National Bureau of Standards, Washington, D.C., United States of America, full-sized bridge and structural members are indeed tested to destruction, and we believe on accurate machines which permit graduated loads of any amount up to the capacity of the machines, together with an accurate determination of the load.

(3) One machine in our laboratories has a capacity in compression of 4460 long tons (10,000,000 lb.), and is provided with an auxiliary beam on which to make transverse tests. Girders 22ft. long can be tested on it up to a load of 480 tons. Another machine, with a high degree of sensitivity, can exert a force of 1026 long tons (2,300,000 lb.) in compression and 510 long tons (1,150,000 lb.) in tension. While neither of these machines is a universal testing machine, we find that nearly all tests for which there is a demand can be accurately made on these or some of the other testing machines in our laboratories.

L. J. BRIGGS, Acting Director.
GEORGE K. BURGESS, Director.

Bureau of Standards, Washington,
September 7th.

The B.T.H. Magneto Works.

THE British magneto industry, which was created as a result of the war, has made very considerable strides, and a visit to such works as those of the British Thomson-Houston Company at Coventry should remove any doubts that may exist as to the ability of British manufacturers to turn out magnetos comparable with those produced abroad. A visit which we paid to the above company's Coventry factories on Wednesday last served to convince us that although prior to 1914 there was practically no magneto industry in this country, the art of making these machines has now been brought to a high stage of perfection, and that those who are still under the impression that good magnetos can only be obtained from Germany are very much mistaken. At these works a highly efficient system of manufacture has been established, and apart from the usual economical lay-out of machine tools, &c., the organisation takes into account other important factors, such as synchronising the factory output with the future requirements of the sales department, rapidly increasing or decreasing production as occasion requires, and ensuring that the time for conversion of the raw material into the finished product is as short as possible, so that the ratio of tied-up capital to turnover is reduced.

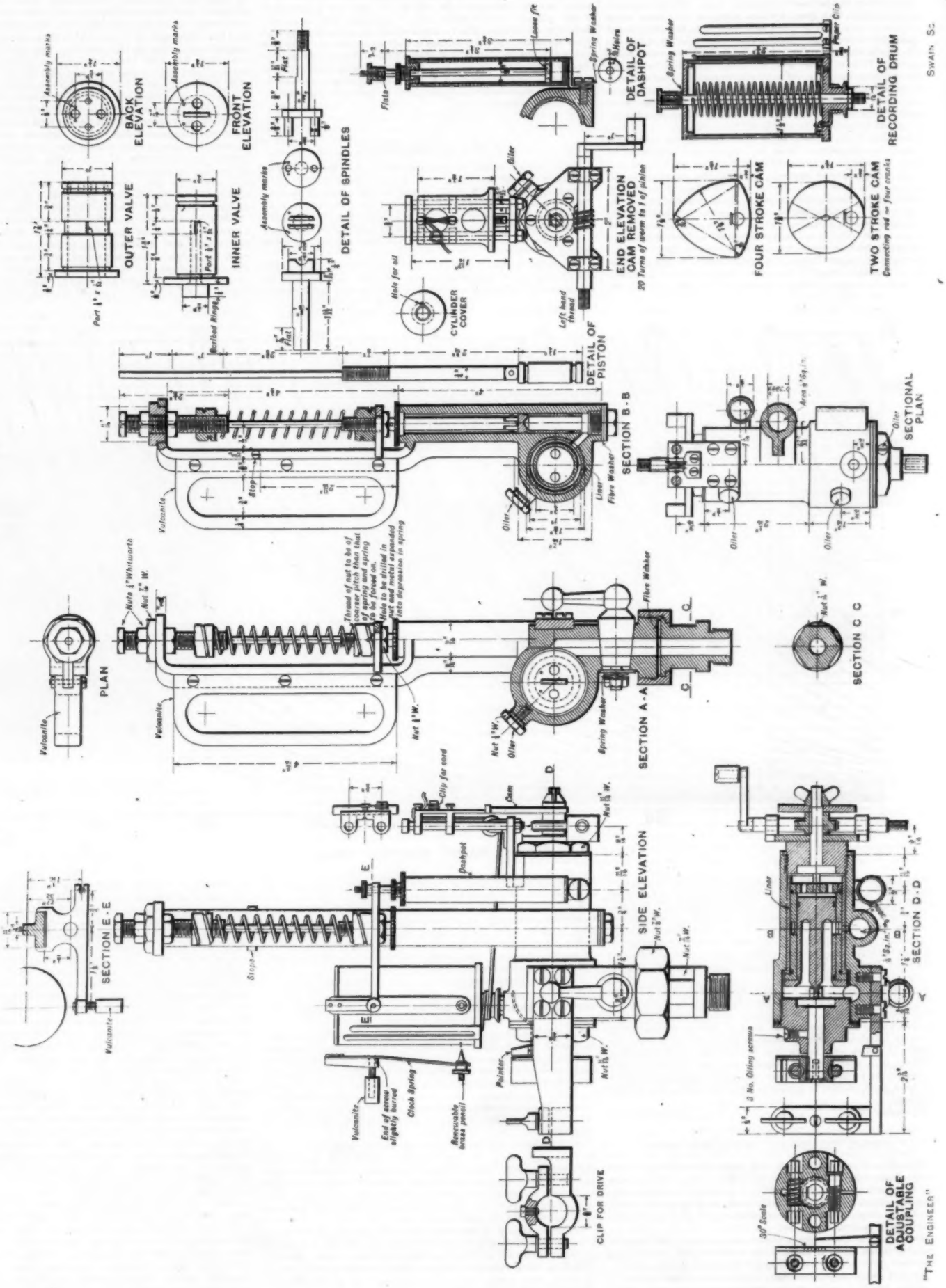
In order to meet these fundamental considerations, the output required of the factory for definite periods is estimated, and the working programme drawn up, the raw materials being arranged to flow in the requisite quantities at stated intervals, as required. After a rigid inspection and, where necessary, tests, the raw material passes through a main control station, where by means of an indicator control board it is possible to ascertain at any moment the amount of material to be sent to any particular department for a week's work, any arrears of material either from outside sources or elsewhere, and a true record is given of replacements required to cover wastage. Each departmental head knows exactly the rate of work required of him for a specified period. By means of this system the orthodox methods of storing raw materials and partly finished components in the process of manufacture have been eliminated, with the result that the capital investment is considerably reduced. Moreover, the system responds very rapidly to any fluctuations in the demands of the sales department, and has the additional advantage that changes in design can operate very quickly at specified periods, with an almost perfect balancing of the parts involved.

While it is not our intention to describe the technical details of the factories on this occasion, we may mention that all the machines produced at the Coventry works are subjected to very rigid tests, and all the component parts are carefully inspected to ensure that they conform strictly to the specified dimensions. On many dimensions the tolerances are so fine that a systematic daily check on the gauges is necessary. Such components as armatures, condensers and moulded insulation parts are subjected to strenuous tests, during the various stages of manufacture, and the complete magnetos are finally run for long periods at high speeds, after which they are tested for low-speed sparking performance. The sparking voltage of the magnetos during the high and low-speed tests is more than twice the sparking voltage when operating under normal conditions, thus ensuring a high margin of safety against any electrical breakdown during service. A striking testimony to the reliability of B.T.H. magnetos is their almost exclusive use for aviation in this country.

The general efficiency of the operators has been closely studied and everything possible is done to create bright, cheerful and healthy conditions. In accordance with a definite colour scheme, the shops are painted pale blue and white, and all female workers in the assembly and winding departments are provided with pale blue uniforms.

GALE MECHANICALLY-OPERATED HIGH-SPEED INDICATOR

(For description see opposite page)



"THE ENGINEER"

The Gale High-Speed Indicator.

THE high-speed indicator illustrated on the opposite page, the invention of Mr. C. H. Gale, M. Inst. C.E., resembles the Royal Aircraft Establishment's electrical indicator,* in so far that the diagram produced is composed of a succession of points, each point being obtained on a successive cycle of cylinder events. It differs from the R.A.E. instrument, not only by virtue of the fact that its operation is wholly mechanical, but in the important respect that the pressures are recorded on the normal basis of an indicator diagram, namely, that of piston displacement, and not on a crank angle or time basis, which requires subsequent reduction to the piston displacement basis. The diagrams obtained with the Gale indicator are not, however, quite identical in form with the normal type. They may be described as double length diagrams, as resembling those that would be obtained from a four-stroke cycle engine if the drum carrying the card continued to rotate during the exhaust stroke in the same direction as that in which it rotated during the expansion stroke and then, reversing, moved backwards in the opposite direction during both the suction and compression strokes. The positive portion of the diagram therefore lies to the left of the centre line, and the portion representing the normal negative loop to the right of the centre line. This departure is not, however, essential to the design of the instrument. It has been introduced because it was readily obtainable, and was regarded as an improvement. It would be quite possible to arrange the indicator to give diagrams of the usual looped pattern.

The pencil, drum and spring are more or less of normal design if we except the fact that no pains are taken to reduce their inertia. Absence of inertia is not necessary to accuracy in the diagrams, for the reciprocating parts move very slowly. Massiveness in the spring and its connections, a massive piston and a long, relatively heavy spindle between the piston and the spring, are features of the design. Their character is dictated not only by considerations of robustness but because inertia in these parts is desirable rather than otherwise. As impulse succeeds impulse on the piston with great rapidity, the inertia is such that the spring is given little time to communicate velocity to the pencil, and the magnitudes of the impulses are recorded without the pencil dropping between each pair of impulses farther than the proper amount corresponding to the reduction of pressure in the cylinder. The pencil is mounted at the end of a horizontal arm, which is guided directly, without a parallel or multiplying motion, to rise and fall in a straight line. The horizontal arm is held between two nuts on the piston-rod, and at the end remote from the pencil is attached to the plunger of an oil dashpot. This dashpot is not provided with the object of damping any momentum acquired by the pencil and piston between the impulses—although no doubt it assists in that direction—but to eliminate the accidental vibrations that would otherwise be transmitted from the engine to the pencil.

The all but instantaneous impulses of pressure are admitted to the indicator piston by means of two rotating cylindrical valves, one housed within the other. The inner valve is coupled to the engine, so as to be driven at half the engine speed in the case of a four-stroke cycle engine, and at the full engine speed in the case of a two-stroke engine. The outer valve is driven by hand at any convenient speed—say, one turn in ten seconds—by means of a handle and a small worm and worm wheel gear. Each valve is formed with a port $\frac{1}{4}$in. long by $\frac{1}{32}$in. wide. When these two ports register the pressure in the engine cylinder reaches the indicator piston by way of a hole drilled axially up the inner valve. The second symmetrically disposed axial hole in the inner valve is formed simply for balancing purposes.

It might be thought that the small size of ports in the valves would result in the creation of wire-drawing and produce faulty diagrams. The whole volume filled with gas between the point of attachment of the indicator to the engine cylinder wall and the indicator piston amounts only to 7 or 8 cubic centimetres, and the pressure within this space undergoes one complete cyclic variation in ten seconds or thereabouts. As many as six or seven hundred revolutions of the engine may occur between the start and finish of the diagram, so that the change of pressure occurring between two successive impulses must necessarily be slight. On examination of two typical cards taken with the indicator we find that the fall of pressure between two successive impulses on the explosion stroke averages from 2·7 lb. to 3 lb. per square inch. It is, therefore, argued by Mr. Gale that the flow through the ports is insufficient in magnitude and speed to produce any material amount of wire-drawing.

It is clear that if the outer valve is not rotated the two ports will register always at one and the same point in the cycle of engine events, and that the indicator pencil will take up an unvarying height corresponding to the pressure in the engine cylinder at that point in the cycle. If the outer valve is rotated through 360 deg. in either direction—preferably, for the sake of preserving the oil film and maintaining the gas tightness of the valves, in the same direction as the inner valve—the instant of registration of the ports can be made to traverse the whole cycle of engine events. In such a case the drum, if given an appropriate reciprocation, will receive on its paper a more or less conventional indicator diagram, actually one composed of a large number of very fine steps. It is of little moment whether the outer valve is rotated uniformly or, within reason, non-uniformly, for the effect of non-uniform rotation will simply be to increase or diminish the number of steps at some points of the diagram and will not affect the size of the diagram.

The communication of the correct motion to the drum is a matter requiring careful consideration. One turn of the outer valve completes the diagram, and in the interval occupied by this turn the drum has to make one complete to-and-fro movement, whether the engine is of the four or two-stroke cycle type. With a two-stroke engine the angular displacement of the drum has to be proportional to the displacement of the engine piston from one end of its stroke at the instant when the ports in the two valves register. With a four-stroke engine, in order to obtain an unlooped diagram, the displacement of the drum has to be proportional to the displacement of the engine piston measured from both ends of the stroke—if we may so express it.

The movement of the drum is produced, not in the usual way by a rig connecting it to some reciprocating part of the engine but by a cord attached to a slide, which is raised and lowered on two vertical guide rods by the action beneath it of a cam fixed to and rotating with the worm wheel shaft driving the outer valve. The form of the cam is arrived at by a geometrical construction into the details of which we need not enter. It is sufficient to say that the proportions of the cam depend upon the ratio of the connecting rod length to the crank radius, and that the form depends upon the number of strokes per engine cycle. For a two-stroke engine the cam is more or less an excentrically mounted ellipse, and for a four-stroke engine more or less an excentrically mounted triangle. In the position in which the four-stroke cam is represented in the engraving—assuming that it is given anticlockwise rotation—the lower left-hand apex when beneath the slide corresponds with the end of the suction stroke, the apex at the top to the end of the compression stroke and the lower right-hand apex to the end of the expansion stroke. The point vertically below the axis corresponds with the end of the exhaust stroke.

The cam cannot be set otherwise than in the correct position relatively to the outer valve, and consequently there is a fixed relationship between the displacement of the drum at any instant, and the angular displacement of the port in the outer valve. There is therefore a definite position of the port in the outer valve for each event in the engine cylinder. Hence it is necessary to couple the inner valve to the engine in such a way that the event corresponding to the momentary position of the outer valve port will occur at the instant when the two ports register. In other words, the coupling must be made in such a way that the phase of the engine events will agree with the phase of the drum motion.

This requirement is provided for by means of an adjustable coupling at the end of the shaft driving the inner valve. The coupling consists of a split flange containing a clamping screw and a worm meshing with a worm wheel on the end of the inner valve shaft. When the clamping screw is freed the worm wheel, and the inner valve with it, can be turned relatively to the split flange. A scale and pointer are provided to show the angular position of the inner valve. In use the engine is set on the top dead centre, the indicator drive is connected up, and the inner valve adjusted until the centre mark of the scale registers with the pointer. With this setting the ports in the two valves will register when the piston of the engine is on the top dead centre and the drum of the indicator is at one limit of its movement. In other words, the movement of the drum will be in phase with the movement of the engine piston. The correctness of the phase setting may be tested by removing the sparking plug from the engine cylinder and running the engine as an air pump. If the phasing is correct the expansion curve obtained on the card should follow the compression curve. The scale provided on the worm wheel element enables any fine adjustment required in the phasing to be controlled.

We have now described the main features of the construction of the Gale indicator. Several points of detail may be mentioned. The only portion of the indicator driven by the engine is the inner valve, and as the motion of this part is purely rotary and at constant speed, no inertia troubles are introduced. All the reciprocating parts are massive, but they are driven slowly by the hand motion or in the case of the indicator piston and its attachments by the spread-out effect of the pressure impulses. Inertia effects are therefore absent. The cord driving the drum is very short and cannot materially affect the accuracy of the diagram by stretching. The piston spring is external to the indicator cylinder and does not suffer any temperature effect.

The valves are made of hardened tool steel, and, in order to overcome expansion difficulties, work inside a hardened steel liner. Initially gun-metal and invar—iron and nickel—alloy were tried, but unsatisfactory results were experienced, the invar especially giving trouble. It was found that the fine clearances demanded if gas-tightness were to be obtained led to the production of grit on the contacting invar surfaces. The spaces at the right-hand ends of the two valves are charged with oil, and with the tool steel valves no seizing, we are informed, has ever been encountered. The design of the driving details is such that no binding action can be thrown upon the valves. The indicator piston is of unusual length. It is formed with two oil packing recesses, and above it a layer of oil is allowed to accumulate. In view of the long period during which the piston has to hold the pressure, these means are necessary, and, we are informed, have proved effective for, the prevention of leakage.

It is claimed by Mr. Gale that the indicator enables diagrams to be taken in a satisfactory manner from engines running at speeds too high to be dealt with by any other form of indicator, whether mechanical, electrical, or optical. We have inspected diagrams taken with it from a J.A.P. motor cycle engine, running at 3000, 3600, 4400 and 4800 revolutions per minute. In all cases the diagrams are distinct and reasonably free from minor irregularities. The instrument is not, however, exclusively applicable to high-speed internal-combustion engines. It can be used with the two-stroke cam in position for indicating steam engines. In addition, the length of the indicator piston and the steps taken to prevent loss of pressure by leakage make the indicator particularly useful, it is claimed, for indicating engines such as those of the Diesel type, in the cycles of which high pressures occur, no matter whether the speed is high or low. A light spring of 16 to 1 ratio can be substituted for the normal 160 to 1 spring to obtain an enlarged diagram of the low-pressure portions of the cycle.

The sole distributor of the instrument is the British Oil and Turpentine Corporation, Ltd., 57-58, Chancery-lane, London.

* See THE ENGINEER for January 26th, 1923.

WORK has been started on the Bridge River hydro-electric scheme in British Colombia. It will be the largest development of its kind in the province and will involve the expenditure of 30,000,000 dollars.

Sixty Years Ago.

IT is a well-known fact of history that James Watt fully foresaw the advantages to be derived by dispensing with reciprocating motion in steam engines, and that he and many others of his time and immediately after it laboured to produce a practicable rotary engine. Sixty years ago the problem was being extensively studied, but no completely satisfactory design had so far been evolved. The day of the steam turbine was still many years ahead. It is curious to note, as we do in a paper on rotary engines, read by Mr. G. D. Hughes before the British Association and reprinted in our issue of September 21st, 1866, that Hero's engine, a steam reaction turbine in principle, was familiar to the engineers of that date, but that they regarded it in their "enlightened age" as simple and crude. Actually the turbine of to-day is in certain forms more akin to Hero's engine than it is to the rotary machines on the design of which our fathers and grandfathers spent so much time and thought. Mr. Hughes in the paper referred to described and illustrated a rotary steam engine, the invention of Mr. W. Hall, of Nottingham, which he characterised as the best arrangement of the kind that had up to that date come under his notice. Mr. Hughes exhibited a small working example of the Hall engine, which had for a considerable time been in use driving part of the machinery at a local exhibition. A larger example to work with boiler steam at 60 lb. and to indicate 65 horse-power was, it was stated, then being constructed to drive Mr. Hall's timber mill. The engine was of the excentric, rotary piston type. In the 65 horse-power example the cylinder was 24in. in diameter and 3in. long. Centrally through it there passed the driving shaft on which was mounted an excentric "piston" 18¼in. in diameter and also 3in. long. The end faces of the piston made steam-tight joints with the end covers of the cylinder and a metallic packing strip, let into the piston parallel with its length and at the end of its maximum radius, made a similar joint against the cylinder wall. Directly over the driving shaft a slide projected into the cylinder with its lower end resting against the periphery of the piston. As the piston revolved its excentric motion communicated a rise and fall to the slide. A steam passage was formed down the slide, and near the foot of the slide this passage was curved to deliver the steam horizontally into the cylinder. When the maximum radius of the piston was vertically below the slide admission of steam was cut off, but shortly afterwards the rotation of the piston would allow the slide to fall and admit steam into the small curvilinear triangular space between the cylinder, the piston and the slide. The steam pressure exerted in this space caused the excentric piston to rotate, and the volume of the space to increase until the maximum radius of the piston had turned through about 345 deg., at which point an exhaust port in the cylinder wall was uncovered. Some time before exhaust began the re-ascent of the slide had cut off the steam supply. The advantages of this design of engine were set forth, and among them strong prominence was given to its compactness and its suitability for marine use. To-day its disadvantages are more apparent than its advantages, but one point in its favour as compared with modern steam turbines should be mentioned. Its performance could be measured by means of an indicator. Sample indicator cards taken on Mr. Hall's engine were, in fact, included in the paper.

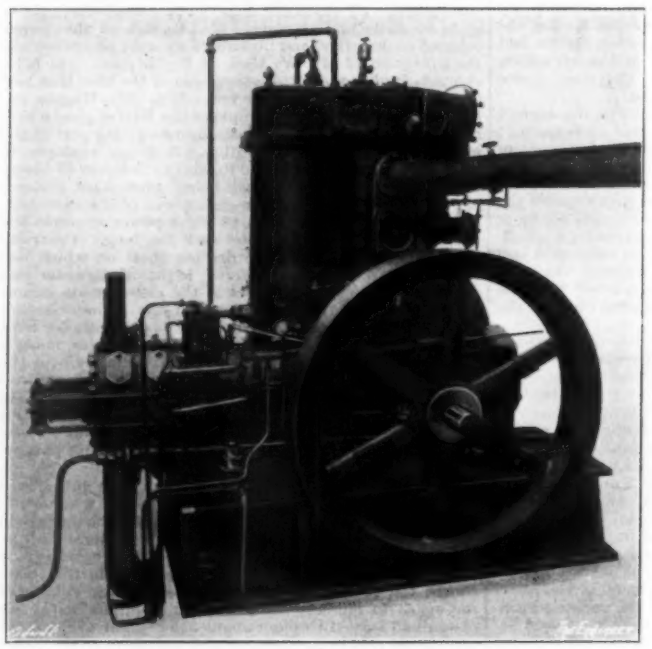
Oil Engine-driven Air Compressor.

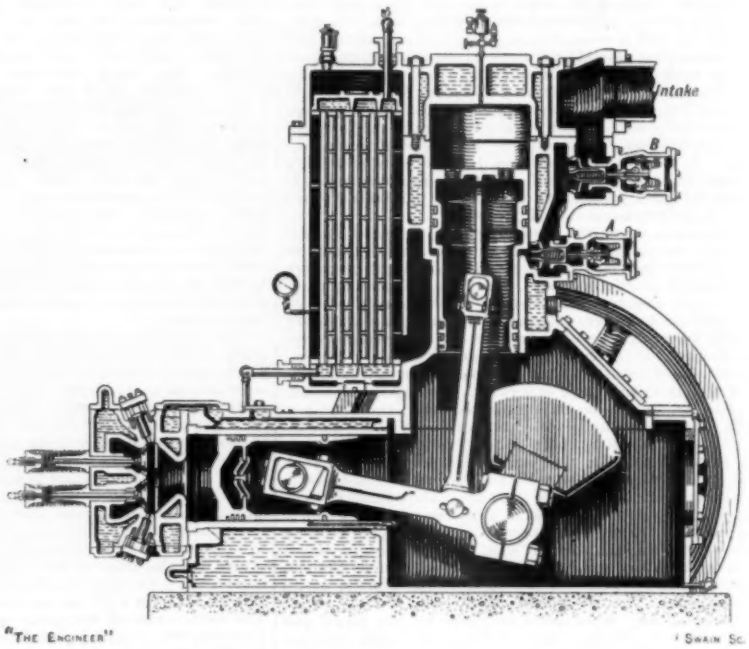
WE recently had an opportunity of inspecting a 50 horse-power direct-connected cold-starting oil engine and air compressor, which is being introduced by the Ingersoll-Rand Company, Ltd., 165, Queen Victoria-street, London, E.C. This particular installation has been in continuous operation for some time in a Derbyshire mine, where it is supplying air at a pressure of 100 lb. per square inch for power purposes. The engine is of the four-cycle solid injection type, and is fitted with a compressed air self-starter. It is of the single-cylinder, single-acting horizontal pattern, and has built on to it a vertical two-stage air compressor and intercooler, the compressor piston, which is of the differential type, being operated by a connecting-rod through a pin and slotted hole in the engine connecting-rod. Outstanding features of the engine are the shape of the combustion chamber and the arrangement and construction of the spray nozzles used for the solid injection of the fuel, whereby it is claimed a very complete atomisation of the oil is effected. Other important features are an enclosed and oil-tight crank case, pressure lubrication for all important bearings, including the cam rollers, continuous filtration of the lubricant, and a completely water-jacketed cylinder liner and cylinder heads.

The engine consists of a heavy cast iron frame, and the cylinder is integral with the frame. The cylinder is fitted with a cast iron liner, and there are two separate cylinder heads which together form the combustion chamber. The liner is pressed into the cylinder, one end of it being held firmly in place against a shoulder; and packing rings fitted into grooves at the free end constitute an expansion joint to prevent water from leaking into the crank case. This arrangement permits of easy removal of the liner for reboring or inspection. The cylinder walls are completely jacketed and are fitted with doors for cleaning purposes. The inner and outer cylinder heads are secured to the cylinder by means of eight studs, which are screwed into the latter, and no gaskets are used between the various joints which are ground. Instead of leading the circulating water through the joints it is carried around outside by means of by-passes, an arrangement which prevents the water from being drawn into the cylinder. The inner head contains the air starting valve, and the outer head contains the suction and exhaust valves, two spray nozzles and indicator connections. Bolted to the outer head is a bracket which carries the levers for operating the exhaust and suction valves. The fuel injection system is shown in Fig. 3. The injection pump and service pump are contained in a casing made from a solid block of steel. The injection pump plunger works in the upper part of this block, while the service pump plunger works in the

lower part. The latter pump takes the oil from the storage tank, lifts it to an elevated filter, and from that point it flows by gravity to the intake of the injection pump. The plungers of the service and injection pumps are connected by a yoke and are operated simultaneously by means of a single rod, carrying on its opposite end a roller which bears on a cam on the cam shaft. This cam actuates the pumps on the discharge stroke. A strong spring withdraws the plungers on the suction stroke, thus keeping the roller in contact with the cam at all times. The pump plungers are made of hardened steel, and are lapped in their respective barrels. No stuffing-boxes or glands are employed.

All the valves in the fuel pump are hardened, ground and lapped, and the suction and discharge connections and the by-pass discharge connections are made with ground joints and held in place in the pump body by a single steel clamp. The suction and discharge valves are of the spring-loaded poppet type. The by-pass valve is closed by a spring and opened by a lever connected to the pump plunger. The point in the pump stroke at which the by-pass valve opens is regulated by shifting the fulcrum on which this lever bears, and the governor controls the shifting of this fulcrum. The injection pump comes into operation as soon as the engine is turned over with compressed air, and fuel oil is forced through the discharge pipes simultaneously to both nozzles. The pump cam is set so that the injection may occur at the proper point in the cycle. The two sprays come together at the same time as the air—driven forward by the engine piston—is directed to the centre of the impact of the sprays by the neck or restricted opening in the combustion chamber.





"THE ENGINEER" SWAIN SC.

FIGS. 1 AND 2—INGERSOLL-RAND OIL ENGINE-DRIVEN AIR COMPRESSOR

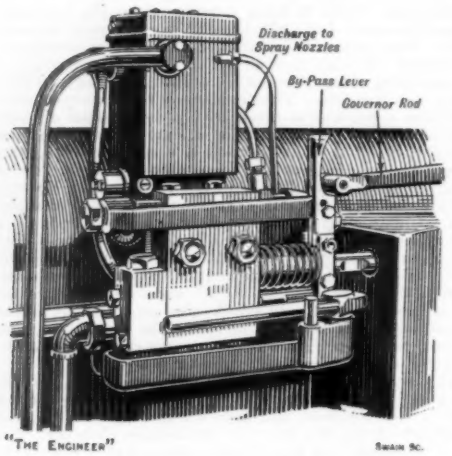


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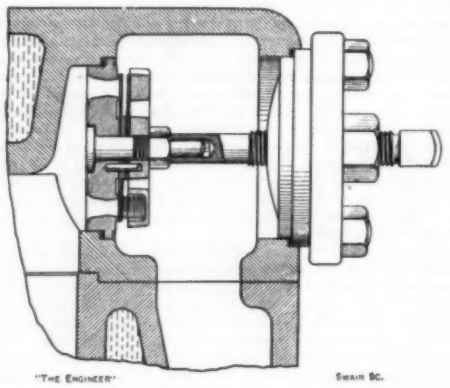
FIG. 3—FUEL INJECTION SYSTEM

This arrangement results in turbulence and so diffuses the air and oil vapour.

The piston has a skirt of great length, the head end being fitted with one or more rings of the ordinary type. Beyond these are rings of special design consisting of a single outer section with a bevelled inner face, six inner sections with a bevelled face corresponding to that of the outer ring and six flat steel springs. The last named force the rings out against the cylinder walls, and the wedge action of the bevelled faces keeps the ring in constant contact with the side of the groove, thus preventing the passage of lubricant inward as well as that of the gases outward. The piston at the inner end has a wiper ring, and the space between the working rings and the wiper ring is vented to the atmosphere through passages in the cylinder walls—as shown in Fig. 2. A cover plate shown inside the piston is fitted to prevent oil from the crank case being thrown to the inside of the piston head, and forming a carbonaceous deposit. The connecting-rod has a hole extending throughout its entire length, through which the lubricating oil travels from the crank pin bearing to the gudgeon pin bearing. The small end of the rod is of box section, and contains the gudgeon pin bearings, which are of cast iron lined with bronze. A wedge is provided for quick adjustment. The big end is of the marine type in halves with provision for shims. The cam shaft, on which are mounted the cams for operating the injection pump, air starting valve and suction and exhaust valves, is operated by a gear wheel on the crank shaft, and the whole is enclosed in a compartment in the main frame for protection from dirt, &c. These parts are lubricated under pressure. The engine governor is operated through a vertical shaft and bevel gear from the cam shaft gearing, and the exhaust and inlet valves are worked by push rods and cam levers, having rollers which bear on the faces of the cams on the cam shaft. The outstanding feature of these cam levers is a ball and socket joint between each of the push rods, and levers. The ends of the push rods, which are hemispherical in form, fit into sockets in their respective cam levers, and are retained in place by the force of the valve springs. A similar ball and socket joint construction is used for the connection between the push rods and the valve operating lever at the head end of the engine. With this arrangement it is an easy matter to assemble and disassemble the valve operating mechanism. To remove a push rod it is only necessary to compress the valve spring and lift out the rod. The push rods are made of steel tubing of large cross-section to prevent sagging or springing.

The starting valve for admitting air during the starting period is attached to the cylinder head. The operating rod passes through an opening in the frame and receives its motion during the starting period from a cam similar to that used for operating the main valves.

The governor is of the centrifugal type. Change in the angle of the balls, due to change in speed, shifts the fulcrum of the by-pass lever—shown in Fig. 3—and varies the quantity of the fuel charge. The governor balls are enclosed in a metal casing.



"THE ENGINEER" SWAIN SC.

FIG. 4—AIR VALVE

The air compressor cylinder—shown in section in Fig. 2—is of the two-stage differential type, both high and low-pressure ends being cast in one cylinder. The barrel and the head of the cylinder are water jacketed, and the air passages are large and unrestricted. The air valves, both inlet and discharge, are of the disc pattern—Fig. 4—and operate automatically. Each valve is composed of a flat disc of steel held in position by a steel guide plate, and on top of the valve is a stop plate to limit the valve opening movement. Helical springs in this stop plate close the valve at the end of the stroke, while a washer placed between the valve and the seat determines the amount of the valve opening. Each valve is mounted as a single unit, the valve, guide and seat being clamped together by a bolt and nut, and dowelled to prevent turning. The valve parts are held in position by a set screw passing through the valve cover and over the outer end of a clamp bolt. By tightening the set screw the valve is positively locked in place. The set screw is securely held by a lock nut.

The intercooler is shown in section in Fig. 2. Air from the low-pressure discharge enters the intercooler casing and passes upwards around the tubes through which the cooling water flows, the passage of air being baffled. To allow for expansion and contraction the tubes and inside water head are free, and the entire nest of tubes can be withdrawn for cleaning.

The compressor piston is of the differential trunk pattern with two sets of rings for each diameter, while an additional wiper ring is provided at the lower end of the piston. The air compressor connecting-rod is of forged steel having a solid end with removable split bronze crank-pin and wrist-pin bearings, each having wedge adjustment.

Under general conditions of service air compressors are not required to operate at full load at all times, and it is therefore necessary to provide some means of automatically regulating the output. Most systems are dependent upon the pressure in the air receiver. When the final desired discharge pressure is reached, means are provided to "unload" the compressor, and when the pressure in the receiver falls again to the predetermined minimum, regulators are provided to reload the compressor. Further, when an air compressor is direct connected to the prime mover, such as an oil engine, it is absolutely necessary that the work of compressing the air should be temporarily relieved in order that the engine may be easily started. In the compressor under notice regulating or by-pass valves—shown at A and B in Fig. 2—are provided on both the high and low-pressure cylinders. During the loaded period these valves are closed and the compressor functions normally, compressing the air in two stages and delivering out of the discharge valves into the receiver or pipe line. When the compressor is unloaded these by-pass valves automatically open the discharge passages of both cylinders into the intake passage and the work of compressing the air is suspended. The main by-pass regulator valves are operated by compressed air, which is admitted to, or emitted from, the valves by means of a small auxiliary valve not shown. This auxiliary valve is connected to the air receiver, on the one hand, and to the compressed storage cylinder, used for starting purposes, on the other hand.

MINE WAGON DUMPING MACHINE

To save time and labour cost in the delivery of coal from the mine trucks or wagons to railway coal wagons or to storage piles, the use of rotary dumping or tipping machines is increasing rapidly at American mines. In principle, the wagon runs into a skeleton cylinder of steel framework and is automatically latched, the machine then revolving on its axis so as to invert the wagon. An apron or hopper receives the coal and delivers it to the railway car or stock pile, so that the coal is poured rather than dropped, and there is less breakage than if drop-bottom wagons or tip wagons are used. The dumper may be operated by various arrangements of power, but usually cables attached to the revolving frame are attached to the piston-rods of steam or pneumatic cylinders, or to drums operated by electric motors. Ordinarily, the dumping cylinder handles one or two mine wagons at a time, but much larger numbers are handled to meet special requirements. In one notable installation an entire trip of twenty-six wagons is dumped in one operation, without uncoupling the haulage rope or uncoupling any of the wagons. The load of 78 tons of coal is dropped into a large storage bin. No attendants are required, as the brakeman, riding on the rear of the trip or train, steps off as the train comes to rest and operates the electrical control. The train is unloaded and ready to be lowered down the incline in seven to ten seconds after it has landed in the dumper. In this way the capacity of the incline has been increased 25 per cent.

Railway Matters.

A CONTRACT has been placed by the London, Midland and Scottish Railway with Logan and Hemingway for considerable alterations in the neighbourhood of Staveley, on the former Midland section.

A PASSENGER train ran into a light engine outside Holbeck, London and North-Eastern Railway, on Saturday morning last. From the Press reports we imagine that the light engine was waiting to enter the engine shed and was overlooked.

ON Thursday afternoon, September 23rd, it was reported that an express from Lyons to Paris ran into a standing train between Melun and Montereau, several passengers being killed and many injured. It appears that the standing train had also left Lyons, but owing to a break-away at Vilaines-sur-Seine it had come to rest. A serious railway accident in Japan, owing to a derailment, was reported on the same day.

THE latest returns for the Harwich-Zeebrugge train ferry show that during the second quarter of this year the tonnage carried was 28,839 tons, compared with 18,595 tons for the corresponding period of 1925. Fruit packed in Southern Italy has been delivered in London and Manchester in the same trucks. The new Pullman coaches for the Sud Express, Paris to Biarritz, were safely dispatched from the works in Birmingham to Paris without reshipment.

THE Peruvian Corporation has received cable advice that the deviation of the line of the Central Railway and the construction of the new tunnel at Puruhuay—some 50 kilome. from Lima—have been completed and opened for public traffic on September 15th. The danger of future serious damage by floods at this point will therefore be avoided. The company operates 1336 miles of railways in Peru. The report for the year to June 30th, 1925, issued in November last, intimated that the railway receipts had been seriously affected by floods.

CLAY miners are now busily engaged in driving a new Underground Railway tunnel, through which the public will never travel. This tunnel is nearly 1000ft. long and is situated at King's Cross. It will eventually connect the Piccadilly and City line tubes, and will enable the rolling stock of the latter line to get through to the general overhaul depôt at Acton Works, where it can be overhauled more conveniently than at Golders Green, where this work is now done. The greater part of the new tunnel has now been excavated, and another month or so's work will see the task complete.

THE winter train service came into operation on Monday last. No pronounced changes were made, but it may be mentioned that the Pullman service between King's Cross and Bradford is being continued, after arrival in that city, to Halifax *vid* Queensbury, whilst the up connection will start from Halifax, run to Bradford and thence to Wakefield, where it will join the Leeds portion. A useful innovation is the 8.55 a.m. from Paddington to South Wales, which, by its calling at Didcot, allows passengers for Newport and beyond to leave Oxford fifty minutes later and, moreover, to arrive fifty minutes earlier—a net saving of nearly two hours.

THE automatic application of continuous brakes in the case of rupture of the train pipe was not part of the original equipment. It was introduced in the Westinghouse brake in 1875, and in the vacuum about 1878. The benefit of the automatic action was clearly shown when, on the 14th inst., the couplings of the Southern Company's Atlantic Coast Express failed near Woking. Both portions were at once brought to a stand by the automatic application of the vacuum continuous brake. It will come as a surprise to many to know that, according to Sir John Pringle's annual report, 2398 out of the 10,053 cases of failures of couplings last year were in passenger trains, and it may safely be said that in nearly every instance the continuous brake would automatically be applied.

IT was twenty years ago on the 19th inst. since one of the Great Northern down night Scottish expresses passed the adverse signals at two boxes at the south end of Grantham Station, and entering, at a high rate of speed, on to a sharp curve, was derailed. Twelve passengers, one post-office servant, and two railway servants were killed. Why such a careful driver as the man concerned was known to be should overrun the signals was generally regarded as a mystery. Evidence as to his health having been bad was, however, given, and the conclusion arrived at by the company's officials privately was that the man had died suddenly without his fireman noticing it. We allude now to that particular happening in view of the fact that the serious collision on June 19th last at Gray, near Pittsburgh, on the Pennsylvania, was due to a driver overrunning signals. The driver was dead when found, and an autopsy showed that he died from natural causes and not from violence.

THE annual report of the chief inspecting officer of railways on the accidents of 1925 was issued on September 16th as Command Paper Cmd. 2739. It is complementary to the annual returns, issued a month earlier, and referred to in the Journal page of our issue of August 13th. The annual reports of Sir John Pringle contain certain figures, however, that are not in the returns, and are of yet greater value because of the comments on the figures and causes of the accidents of the year. Among other interesting items we learn that the man who was returned as killed at Baker-street, Metropolitan Railway, on June 14th, died from a fatty degeneration of the heart ten weeks after the accident. His death appears in the returns because it is stated to have been accelerated by shock received in the accident. But for that there would have been a clean return, in that respect, as in 1901 and 1908. A gratifying feature in the report is the remark, on the subject of automatic train control, that its adoption, regarded from the point of view of safety, is less urgent in character than when the Automatic Train Control Committee was appointed in October, 1920. It may also be noted that as the liability of passengers falling out of trains in motion is about one in every twenty-eight million journeys, there is no justification to warrant pressure on railway companies to adopt a device for controlling the unlocking of carriage doors. The report can be purchased for sixpence.

Notes and Memoranda.

A SYSTEM of pre-heating the rolls of tin-plate mills by means of electrical resistances has been developed by the Freyn Engineering Company, of Chicago, and is said to have proved to be very satisfactory.

AN exceptionally large ingot was recently produced by the Brightside Foundry and Engineering Company, Ltd. of Sheffield. It measured 85½in. by 89½in. by 153in., and weighed 110 tons. Two anvil blocks are shortly to be cast, one weighing 94 tons and the other 52 tons.

THE official report on the explosion of a steam-jacketed pan in a caramel works reveals a condition of affairs against which the manufacturers of the appliance could hardly be expected to guard. It is, nevertheless, obvious that such conditions must be taken into consideration in designing. The pan exploded through excess pressure, although it was fitted with a safety valve, but the valve was, it appears, so clogged with spilled caramel material that it failed to open.

THE importance of earthing metal bodies other than conductors is stressed by all electricity law-makers, and is denied by few, if any, engineers. At the same time, rules, regulations, &c., covering the installation and maintenance of electric plant and equipment strictly avoid specification beyond that vague expression "satisfactory." A paper by Mr. L. Henshaw recently received from the Institution of Electrical Engineers suggests a starting point for investigation having as its objective the defining of conditions which will preclude all possibility of dispute.

A NEW type of electrically driven mining machine is being tested in various coal regions of America. It is a powerful machine that cuts its way into the face of a bed of coal, breaks the coal loose and loads it into mine cars, without the exercise of manual labour or the firing of a single ounce of powder or dynamite, such as often cause mine explosions. In a test run, this machine was able to bore its way into a coal seam at the rate of 1ft. in 10 min. and at a total mining cost of half that prevailing in the hand-working sections of the same mine. The entry driven in coal by the machine is 6ft. high and 11ft. 6in. wide.

ACCORDING to the *Chemiker-Zeitung*, a Danzig chemist has succeeded in producing lead aluminate by mixing litharge and alumina in molecular proportions, and subjecting the mixture, in the form of small granules, to a temperature of 700 deg. Cent. for a long period. The mixture is originally yellowish in colour, but as the heating proceeds the colour changes to a pure white. No melting takes place, the mixture retaining its solid form throughout. The product finally obtained is a pure white powder of the composition $PbO.Al_2O_3$. The powder is not attacked by dilute mineral acids, and is not blackened by sulphuretted hydrogen. Its covering power is equal to that of white lead.

TELLURIUM, says the *Chemical Trade Journal*, alloys freely with a large number of metals, the tin alloys showing a remarkable hardness and tensile strength, and researches on the tellurium-aluminium alloys proving that they possess remarkable elongation properties. It is of interest that the alloying of aluminium and tellurium takes place with considerable violence and is an operation demanding much skill and experience. The continual increase in the demand for radio and electrical appliances and the impending national electrical developments, including the electrification of some of the railway systems, will bring about an increased demand for such metals as tellurium, the extent of which demand is extremely difficult to foresee.

THE French postal authorities are conducting tests at the wireless station of Croix d'Hins, near Bordeaux, of a wireless telegraphic apparatus which, it is claimed, will, if successful, render the present undersea cables obsolete, while at the same time effecting a considerable reduction in cable rates. The preliminary tests are being made with Antananarivo, Madagascar, and they are described as having, so far, given excellent results. From accounts published so far it would appear that the apparatus is an application of wireless to the existing Baudot system. Transmission by the new apparatus is said to be fifteen times faster than is possible by present methods, while none of the present security or secrecy is sacrificed. The messages are automatically transmitted and printed at the receiving end.

UNDER the auspices of the German and Bavarian Governments and the Kaiser Wilhelm Society, a new water power utilisation research society has recently been formed in Germany. It is proposed to establish a special laboratory on the banks of Lake Walchen in Bavaria, where research work in connection with the economical utilisation of water power will be studied, including such questions as the effect of flowing water on river beds, the design of dams, the most suitable forms of canals, piping and other conduits. The new association will have the advantage of making practical tests at the large and important hydro-electric station which has lately been completed on Lake Walchen. It is estimated that in Bavaria alone there is still about 2,000,000 horse-power undeveloped, and with a similar amount available in other parts of Germany, it is estimated that there exists the possibility of effecting an economy in coal consumption of 20,000,000 tons per year.

THE *Electrical World* states that synchronous condensers, said to be of greater capacity than any ever previously built have been ordered by the Southern California Edison Company for regulating the voltage along the transmission lines which carry electrical energy from remote hydro-electric developments into Los Angeles. Each of the three condensers which are being built by the General Electric Company is rated at 50,000 kilovolt-ampères, 13,200 volts, and 50 cycles, the speed being 600 revolutions per minute. Two are to be installed in the new Lighthipe sub-station and the other in the Eagle Rock sub-station. The largest synchronous condensers previously constructed by the General Electric Company have a capacity of 30,000 kilowatts each, and are in use in the Laguna Bell and Eagle Rock sub-stations of the Southern California Edison Company. For each condenser the manufacturing company is supplying three transformers.

Miscellanea.

THE pumping plant of the Calcutta Corporation is being extended at a cost of £200,000.

AN order for 25,000 tons of rails has been placed with the Dominion Iron and Steel Company by the Canadian Pacific Railway.

A PRIVATE company is erecting a plant for briquetting the brown coal found at Morwell, Victoria, and will consequently come into competition with the State Electricity Commission.

IT is reported that the five leading iron and steel-producing concerns in Japan, representing an annual iron output of 410,000 tons, are to form a syndicate for the sale of iron and steel products.

WORK has been started on the hydro-electric development of Grand Falls, New Brunswick, which will serve two or possibly three pulp and paper mills. The cost of the whole scheme is estimated to be between 28,000,000 and 40,000,000 dollars.

THE Medicine Hat plant of the Canadian Western Steel Corporation, which has been idle for some years, has been purchased by the United States Horseshoe Manufacturing Company, of Erie, Pa. The latter is also negotiating for the purchase of Redcliffe rolling mills, the equipment of which would be moved to Medicine Hat to enlarge the local plant for iron rolling.

THE shipments of the Swedish Iron Ore Trust in August totalled 653,000 metric tons, as against 732,000 tons in August, 1925. The aggregate ore shipments since November, 1925, have reached 4,831,000 tons only, as compared with 6,721,000 tons in the corresponding period in the previous financial year. The reduction, amounting to 1,890,000 tons, is principally due to the falling-off in Germany's purchases.

THE Great Lakes Power Company, Ontario, has plans under way to make improvements in the power canal at Port Arthur in order to meet the increasing power demands, particularly those of the distribution for city and domestic purposes, which are steadily increasing each year. The plans now under consideration will make an increase of 1000 horse-power in the 22,000 horse-power the company is now delivering from the plant to customers.

ON the invitation of the Canadian Institute of Mining and Metallurgy, the second (triennial) Empire Mining and Metallurgical Congress will be held in Canada in August–September, 1927. The opening session will be held in Montreal on Monday, August 22nd, 1927. Further sessions will be held in Toronto, Winnipeg and Vancouver, and the programme will include visits to mines and works, and places of scenic beauty throughout the Dominion. The full programme will occupy about six weeks in Canada.

THE Calcutta Improvement Trust has started work on the reconstruction of the Manicktolla Bridge, by which the Manicktolla main road crosses the Circular Canal. The old bridge is a lattice girder structure with a road width of only 15ft., and is quite unsuitable for modern traffic. In order, however, to save the cost of constructing a new temporary bridge for use during the reconstruction period, it was decided to shift the old bridge bodily to a site 60ft. to the south, where temporary screw pile piers and approach spans had been erected in readiness.

THE stoppage at the British coal pits has considerably helped the Spitzbergen collieries. The Norwegian railways, not being able to obtain their usual supplies of British coal, were obliged to use Spitzbergen coal instead. The opinion is that there is no fear of Spitzbergen coal ousting permanently British coal on the Norwegian railways, but it may depress prices. If the British miners' strike lasts much longer, states the *Iron and Coal Trades' Review*, the Norwegian Coal-mining Company of Spitzbergen will be able to repay the bulk of its debt to the Norwegian Government, which a short time ago stood at 16,000,000 kronor (say, £727,250).

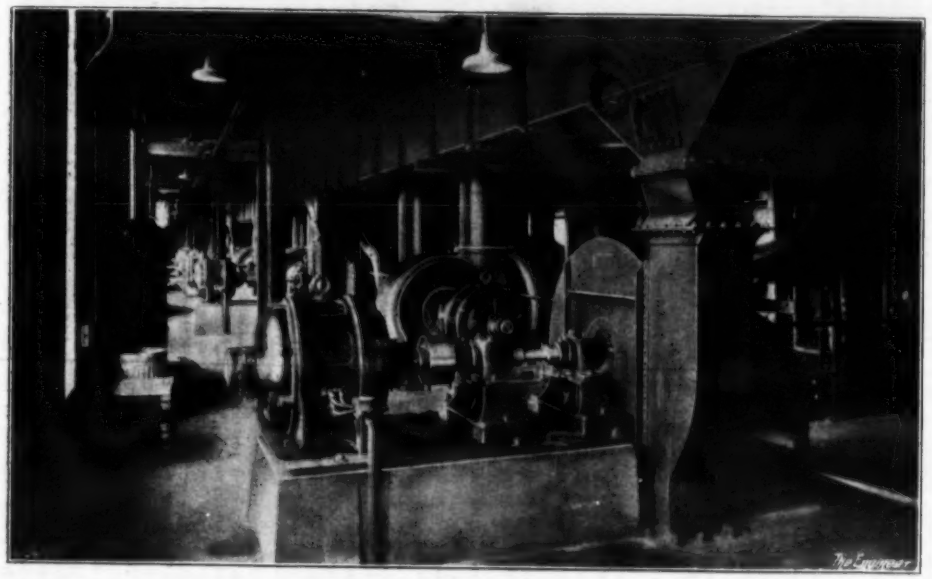
ACCORDING to a report from Vice-Consul Robert L. Buell, Calcutta, India, made public by the Department of Commerce, the Mysore and Bombay hydro-electric projects have increased interest in various parts of India regarding greater development of hydro-electric power. A survey of the Punjab and the adjoining native states has disclosed a potential supply of nearly 2,500,000 horse-power, most of which is capable of economical development. The official programme outlined for the Punjab foreshadows the ultimate completion of a system of electric power transmission lines extending from Peshawar, in the north-western part of India, to Delhi, the Consul states.

CLASSES for firemen and furnacemen in Glasgow will be reopened at the New City Chambers on September 21st by the Glasgow and West of Scotland Branch of the Smoke Abatement League of Great Britain. Instruction is given in the principles of coal combustion and furnace management for successful firing, and models of the more important types of apparatus for smoke prevention will be used to illustrate the lectures. It is stated that the improvement in the atmosphere of the city in recent years is believed to be due largely to the knowledge obtained by the men at the classes, only one member of which was involved in prosecutions for smoke offences during last year. Classes are provided for ordinary and advanced students.

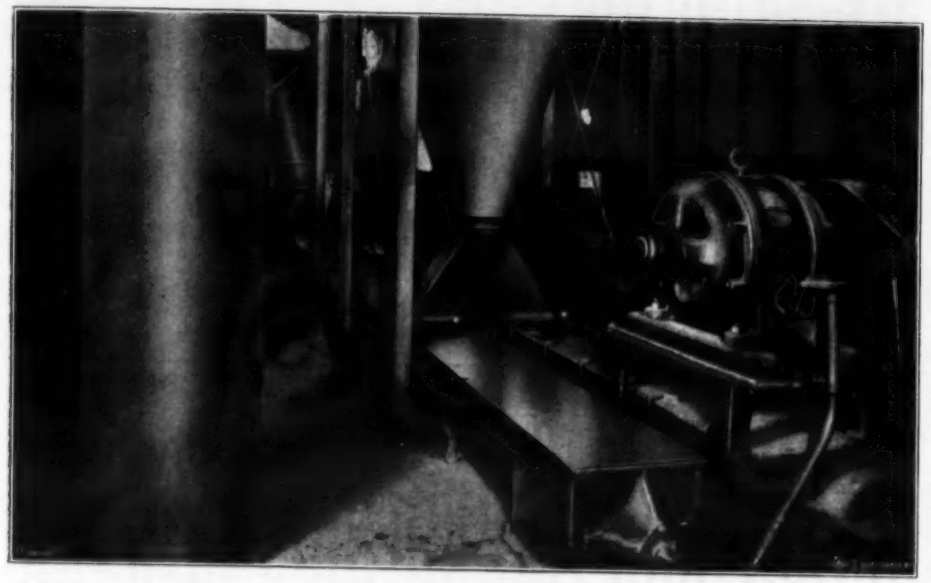
ORDERS have been issued by the Admiralty that the new submarine Oberon is to be placed in commission for trials on Sunday next. H.M.S. Oberon was laid down at Chatham Dockyard in March, 1924, and so has been just 2½ years under construction. Originally named O 1, she will be the first submarine in his Majesty's service to be known by a name rather than by a number. The details of the ship have not been divulged, but it is known that she has a displacement of 1480 tons on the surface and of 1750 tons when submerged. The Oberon is thus much larger than the "L" class submarines, which form the majority of the modern flotillas, but is only about half the size of the experimental submarine X 1 which has just joined the Atlantic Fleet. Two other submarines of the "O" class are under construction for the Royal Australian Navy.

NARROWS POWER STATION, VIRGINIA—PULVERISED FUEL EQUIPMENT

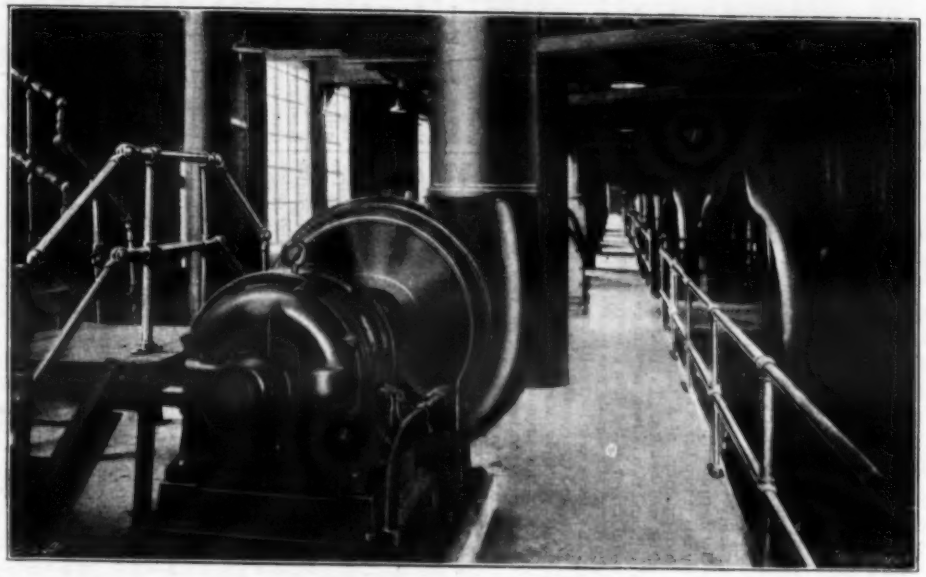
(*For description see page* 340)



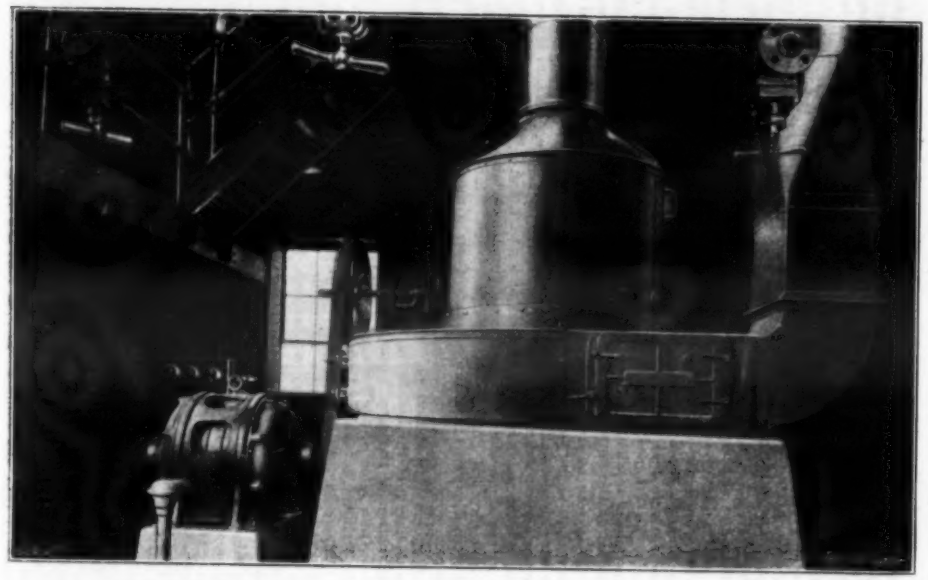
BLOWER FOR AIR SUPPLY TO BURNERS



SCREW CONVEYORS AND MOTOR DRIVE



PULVERISED FUEL EXHAUSTER



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TO CORRESPONDENTS.

*** *All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

By arrangement with Reuter's Engineering Service, **The Engineer** *contains the latest news from all parts of the world which is likely to be of interest to engineers.*

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SIXTEEN-PAGE SUPPLEMENT—"THE METALLURGIST."

The Metallurgist

THE SEPTEMBER NUMBER OF THE MONTHLY METALLURGICAL SUPPLEMENT TO "THE ENGINEER" ACCOMPANIES THIS ISSUE.

THE ENGINEER.

SEPTEMBER 24, 1926.

Freedom.

MR. HENRY FORD has recently published a book called "To-day and To-morrow." It may be regarded as the sequel to his "Story of My Life," and is likely to be as widely read. Its theme is, of course, the development of the Ford industries, and for that reason it is characterised by a certain amount of narrowness. Mr. Ford sees the world through the head lamps of the motor car. Despite the fact that he owns steel works, glass works, saw mills, fabric factories, steamships, mines, and a railway, he regards them only as contributions to his proper business, which, as he himself insists over and over again, is the manufacture of automobiles. Moreover, he has become in the course of his career incapable of seeing things by the ordinary human scale. "Big business," to him, is the only business. He says somewhere that if a business cannot become big it will die; it is not worth going on with. Anything less than mass production does not appeal to him. He tells us that whenever he contemplates undertaking the manufacture of some of the "raw" materials that go to the making of a motor car he begins in a small way; but his small way would, in most cases, be a large way to other people. If he wants to find out how a glass works should be run he buys a glass works; if he wants to know the proper market value of steel he buys a steel works; if he wants to study the economics of railways he buys a railway. We understand that in his hands all these industries pay—by his method of finance—but he could not begin to make them successful were he not able to command capital to an unlimited extent He leaves other firms, howsoever progressive they may be, standing. All things have become possible to him. He can succeed where others would assuredly fail. He has released himself from all shackles and all controls. From an industrial standpoint he is a law unto himself. He has achieved complete freedom; and freedom is the sword with which he has opened his particular oyster.

The manufacturing era opened in this country. It is usual to hold up its early days to obloquy. Individual profit was the object which the factory owner kept before him and by which his success was measured; labour was grossly exploited; factory conditions were notoriously bad; children and women toiled for outrageously long hours in degrading circumstances. Health and even life were but little considered in the race for the markets of the world. It is painful to look back upon those pages of industrial history, but it is unfair to judge them by the standards of to-day. Leisure was barely thought of. The manufacturer himself worked as hard as his employees. Work, work, work was the ruling force. We cannot say, now, that any other course would have been equally successful; we cannot assert that any other course was possible in the circumstances of the time. But we are to-day in this country reaping as we sowed. On their side humanitarian employers, outraged by the conditions, at length forced the Factory Acts upon industry, whilst Labour, on its side, developed trades unionism. At the same time the great industry of merchanding—the middleman—advanced by leaps and bounds, and the necessity for ever more and more capital put industry into the hands of finance. Thus it has come about that manufacturers find themselves in the position of the centre point in a parallelogram of forces. The Factory Acts pull in one direction, trades unionism in another, the middleman in a third, and finance in a fourth. From all these forces Mr. Ford has broken himself free. In the early days he refused to have anything to do with the banks, and after a fight secured freedom from external finance—the public holds none of his shares; the middleman he met by establishing his own depôts; trades unionism he defeated—under favourable conditions—by paying very high wages, and the Factory Acts affect him not, for he has passed beyond them. He has secured absolute freedom to do what he believes is the best that can be done. That seems to us, reading his book, to be the framework of his success. On it he has built up by courage, enterprise, and imagination the vast concern which he controls. But without freedom his history would have been not unlike that of nearly all manufacturers in Europe and all with few exceptions in his own country. Of the four controlling forces which we have named freedom from trades unionism is perhaps the most important. It appears to be complete. The wages question he has settled by paying a basis rate of six dollars a day. Restriction of output and demarcation are not tolerated. The workmen must do what they are required to do, and a skilled hand may find himself sweeping a floor or cleaning machines if there is no other occupation at the moment for him. There are no works committees or workmen's organisations for regulating labour of any kind. Mr. Ford is virtually the commander of a battleship in which implicit obedience to orders is insisted upon. He secures that obedience by steady pay at a high rate, by insured continuity of employment, by regular hours and regular leisure, by favourable workshop conditions and by personal influence. Here are two illuminating figures. In 1913 he paid two and a-half dollars a day and the turnover of labour was 31.9 per cent. per month; in 1915 he raised the rate to five dollars a day and the monthly turnover fell to 1.4 per cent. By doubling the pay he secured what he wanted; the men surrendered themselves to the Ford method. There are many who will see something degrading in this purchase of obedience; many who would rather be recalcitrant and discontented on ten shillings a day than obedient and well off on twenty. The idea of obedience is repulsive to them at any price, and they do not stop to ask if any business of any kind at all can be carried on without it. Sometimes the impression is given that America in general and Mr. Ford in particular flourish because they use more power per man than is used by others. But that is only part of the story, at least as far as the Ford factories are concerned. It is not only that labour is aided by ingenious tools, but that the labour itself is economised. The idea of allowing three men to watch a machine at work whilst two operate it just because it used to be a five-man job is repugnant to all American principles. Mr. Ford endeavours to work with the fewest men possible and there is none to say him "Nay." And the result? Work and high wages for many more. If restriction of output, if demarcation, were insisted upon the Ford system would crumble away. In all this there is a lesson for our own trades unionists. They are on the wrong lines. They can have the high wages when they will agree to work on American principles, but until then it is fruitless to expect great increases in pay. High wages are only possible when the labour costs of any product are relatively so low that increasing them makes but little difference to the total cost. A rough-and-ready rule used to be one-third for material, one-third for oncosts, one-third for labour. In those circumstances it is impossible to

increase labour without greatly affecting the total cost. But change the proportions as some of our motor car builders are doing to five-sixths for material and oncosts and only one-sixth for labour, and wages can be raised with much less serious results. Keep the hours of labour few and the price paid for them may be high.

A problem which must inevitably arise in the mind of every one who reads "To-day and To-morrow" is this. Can the principles on which Mr. Ford has built up his vast business be applied to industries which cannot be conducted on mass production lines? Is it possible, for example, to reduce the proportion that hours of labour bear to materials and oncost by so much in the building of a couple of locomotives that high wages may be paid without serious augmentation of the selling price? Mr. Ford gives us no help in our search for an answer to this question, although he certainly has at his disposal the means of doing so. He has built many single machines for different duties. Has he done so, whilst paying his standard rate of six dollars a day, at a total cost below or no higher than that prevailing amongst the regular makers for the same class of work? That is really the crux of the matter as far as general engineers in this country, and in America too for that matter, are concerned. There can never be any hope of turning out a thousand similar locomotives a day, a thousand similar marine engines, or steam rollers, or cranes, or large dynamos, or big machine tools. Mass production in such things is inconceivable; the "big business" as Mr. Henry Ford sees it is impossible. Makers of such things can increase the ratio of oncosts by using more power, but can they ever bring hours of labour down to such a low figure as is being reached in the mass production of motor cars? We all know that, owing to mistaken principles, trades unionism has prevented that fall in total labour costs and increase of wages which is so much desired, and we hope some day to see someone with lots of courage and ample reserves make the experiment of paying such high wages in a non-mass production works that restrictions and demarcation will be removed. But after all is done, we fear that no approach to the low ratio of labour costs which are secured by mass production can ever be attained in such factories. Some labour economists insist that management should be improved so that higher wages may be paid for the same work. That is a false doctrine. It is fruitless to add to oncosts by the provision of plant if labour plus oncost remains as high as before. High oncosts are only economical when they reduce the cost of labour per piece. To effect a reduction in selling price, which is the object aimed at, the cost of labour per piece must fall more rapidly than the equivalent oncosts rise. The attainment of a just relationship between the two in non-mass production factories presents an interesting problem.

The Cost of Research.

THE description of two famous Dutch research laboratories from the pen of Dr. Rosenhain, which we give on another page, reminds us that the need for research in all branches of industry and technology is perhaps more insistent to-day than it has ever been. While we are second to none in looking towards more settled conditions in Western Europe and the consequent revival of full industrial activity and intercourse among the nations, we cannot shut our eyes to the fact that, as economic recovery is accomplished, there will be not only an increase in markets but also an increase in competition. If we are to hold our own in this competition we dare not lag behind our foreign competitors on either side of the Atlantic in taking the fullest advantage of the possibilities which science offers to industry. We do not propose to enter again into the many well-worn arguments on this subject, but prefer to assume that at all events the more advanced branches of industry have become convinced of the need for the utilisation of research in connection with their business. The point we wish to discuss is this: that even where the value of research is to a great extent recognised, it is often pointed out that it is costly, and that a relatively small concern cannot carry the cost entailed.

That is a view-point which undoubtedly demands some degree of sympathy. With heavy taxation and very high wages and transport costs industry is undeniably heavily burdened, and it is not surprising that a form of activity which does not produce immediate dividends is looked upon as something in the nature of a luxury—indeed, an expensive luxury. Yet this attitude, if persevered in, must lead to the serious deterioration of such an industry. If that is the case—and there is ample evidence that it is—then the support of research, even for a small concern or a backward and weak industry, is emphatically not a luxury, but a necessity. So far from agreeing that the industry "cannot afford it," we must conclude that it cannot afford to do without it. Expenditure of that kind must, then, be regarded as quite as fundamentally essential as other branches of business activity; the industry could not afford to do without its proper equipment for book-keeping and cost-keeping, for instance, and yet these are not directly dividend-earning activities. From another point of view we must regard the progress of research, discovery and invention as the most active cause which renders existing industrial plant and methods obsolescent, and that the only remedy is to make due allowance for the resulting depreciation by investing sums written off on that account in the support of research, which, while it cannot save existing plant and methods from being superseded, can certainly save the works as a whole from being left behind and rendered obsolete. Expenditure on research, viewed in this very sound light, which, we believe, was originally put forward by Dr. R. S. Hutton, becomes a form of provision against a type of depreciation which, while not always immediately visible and obvious, is none the less real and dangerous. From this point of view the expenditure of relatively large sums on research is not only justified, but a matter of business necessity. It must, however, be pointed out that the mere expenditure of a fixed sum is in itself no assurance of success in this matter. The expenditure must be made in such a way as to secure the maximum value in return, and to secure that end it is necessary that the research work itself be rightly directed and economically conducted, and—what is quite as important—that the results are properly understood, appreciated and utilised within the works. The latter requirement is perhaps the most difficult of all, and we will not attempt to deal with it now. The question of the direction and efficiency of research itself bears more directly on our present subject. In this connection it must be realised that just as manufacturing processes have become more complex and demand more specialised and expensive plant, so research also has advanced in directions which demand costly equipment and well-organised teams of highly trained workers. It is, in practice, only the largest industrial concerns—concerns which are, in effect, an aggregate of whole groups of industries—which can themselves support really efficient research organisations. Such undertakings as the General Electric Company of America, the Western Electric Company, or the General Motors Research Corporation are examples of this kind, chosen from America in order to avoid invidious comparisons nearer home. Smaller firms no doubt maintain laboratories, but these are too often swamped with routine or urgent work of a detailed nature that cannot be truly termed research, and are rarely large enough or sufficiently well equipped to attack the more difficult and fundamental problems that call for solution.

The remedy undoubtedly lies in co-operative research, and some of our Research Associations have already shown on a small scale how work of this kind can be successfully carried out. But, with the possible exception of one or two particularly advanced industries, these associations are all still struggling against difficulties which can be summed up in the words "lack of adequate support" from their industry. A contribution, throughout an entire industry, of not more than a farthing in the pound sterling of raw material cost would enable these associations to undertake research or to support it on a scale never yet approached in this country. Looked at, as suggested above, as a depreciation charge, this is a trifling sum. It is pathetic to think that for lack of so small a self-imposed levy some of our greatest industries are running the risk of a future industrial defeat no less serious in its consequences than would have been a military defeat nine years ago.

Literature.

Industrial Furnaces. Vol. I. By W. TRINKS. 352 pp., 283 illustrations. Second edition, 8 vo. Price 22s. 6d. net. John Wiley and Son, New York; Chapman and Hall, London.

THE author of this work is Professor of Mechanical Engineering in the Carnegie Institute of Technology in New York. In this second edition of his book he has brought the information gathered together in the earlier edition up to date, by collection of the new matter in an Appendix. This method of revising books upon technical subjects has much to recommend it, since not only does it reduce greatly the time and cost of preparing them, but it also enables the reader to obtain quickly a good idea of the progress which has been made in the theory and practice of the subject, in the interval which has elapsed between the appearance of the two editions. The value of the Appendix in this particular case is enhanced by a bibliography of the original papers and contributions, used by the author for its preparation.

A brief notice of the first edition was published in THE ENGINEER shortly after the book appeared in 1923, and it is unnecessary to repeat here what was contained in that notice. The Appendix, which extends to thirty-two pages, is the only portion of the new edition therefore which demands attention in this review. It deals with the following subjects:—(1) The Effect of the Heat Radiation of Gases upon Furnace Capacity; (2) the Relation of Time, Space and Temperature in the Heating and Cooling of Solids; (3) Graphical Method of Finding Relation of Temperature, Space and Time; (4) Empirical Equations for Heating Steel; (5) Fuel Consumption of Different Types of Furnaces; (6) Strength and Durability of Furnaces; (7) Furnace Roofs.

On the subject of the heat radiation of gases, the author states that since the first edition went to press, the results of several independent researches on gaseous radiation have been published, and it is now definitely established that even clear gases radiate heat, and that this radiation affects furnace capacity, to an extent not definitely known. The radiation of these gases varies with the kind of gas, with the thickness and shape of the gas-layer, and with the temperature of the gas, as well as with that of the solid that absorbs that radiation. The simple diatomic gases, such as hydrogen, oxygen or nitrogen, neither absorb nor radiate appreciable amounts of heat; carbon monoxide absorbs and radiates some heat, but not as much as the triatomic gases, such as water vapour and carbon dioxide. The hydrocarbons also radiate effectively, and gases that carry a great deal of finely divided carbon are the most efficient, and radiate heat almost like a solid body. For average products of combustion, the gases reach their greatest possible radiation, in layers of from 40ft. to 45ft., and layers of one-half, one-quarter, and one-eighth of this thickness radiate approximately $0 \cdot 8, (0 \cdot 8)^2, (0 \cdot 8)^3$ of the maximum value. These figures must be taken as crude averages, and vary with the composition of the products of combustion. On the subject of the thermal efficiency of different types of furnace, the author gives the following figures for the steel industry:—Rolling-mill furnaces (continuous), 32·6 per cent.; sheet annealing furnace, 27·4 per cent.; ingot-forging furnace (recuperative), 27·7 per cent.; tube welding, 7·2 per cent.; drop-forge furnace (non-recuperative), 5·2 per cent.

The book is well printed, and is bound in uniform style with the other publications of John Wiley and Son, and will form a useful addition to the technical library of all combustion engineers.

BOOKS RECEIVED.

Waterproofing and Damp-proofing Specifications. Ohio: The Master Builders' Company, Cleveland, U.S.A.

The Journal of the Municipal College of Technology, Manchester. Manchester: The Principal, College of Technology.

Marvels of Modern Mechanics. By H. T. Wilkins. London: T. Fisher Unwin, Ltd., 1, Adelphi-terrace, W.C. 2. Price 10s. 6d. net.

Transactions of the Institution of Civil Engineers of Ireland. Vol. LI. Dublin: The Institution of Civil Engineers of Ireland, 35, Dawson street.

The Elements of the Aerofoil and Airscrew Theory. By H. Glauert. London: The Cambridge University Press, Fetter-lane, E.C. 4. Price 14s. net.

Concrete Floor Treatment, Specifications for Hardening, Dustproofing and Waterproofing. Ohio: The Master Builders' Company, Cleveland, U.S.A.

Journal of the Institution of Engineers (India). Vol. VI., July, 1926. Calcutta: The Secretary, the Institution of Engineers (India), 8, Esplanade-row, East.

To-day and To-morrow. By Henry Ford, in collaboration with Samuel Crowther. London: Wm. Heinemann, Ltd., 21, Bedford-street, W.C. 2. Price 12s. 6d. net.

The Venturesome Voyages of Captain Voss. Second edition. With an Introduction by Weston Martyr. London: Martin Hopkinson and Co., Ltd., 14, Henrietta-street, W.C. 2. Price 12s. 6d. net.

"*Hütte*" *Des Ingenieurs Taschenbuch II.* Herausgegeben von Akademischen Verein Hütte E. V. in Berlin. 25, Auflage. Berlin: Wilhelm Ernst und Sohn, Wilhelmstrasse 90, Berlin, W. 66. Price 14·70 R.M.

The Deterioration of Structures in Sea Water. Sixth (Interim) Report of the Committee of the Institution of Civil Engineers. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 2s. net.

U.S. Department of Commerce, Bureau of Mines: Publication I: 16. "*Zinc in 1924*" (*Smelter Report*). By C. E. Siebenthal and A. Stoll. *Publication I.:* 17, *Gold, Silver, Copper, Lead and Zinc in Idaho and Washington in* 1924" (*Mine Report*). By C. N. Gerry. *Publication I:* 18, "*Iron Ore, Pig Iron and Steel in* 1924." By Ernest F. Burchard and Hubert W. Davis; and *Publication II:* 18, "*Lime in* 1924." By G. F. Loughlin and A. T. Coons. Washington: The Government Printing Office, 1926. Price each publication 5 cents.

Models and Analogies for Demonstrating Electrical Principles.

No. VII.*

UNDER the direction of Mr. E. F. W. Alexanderson, of the American General Electric Company, a model has been devised for studying wireless wave polarisation. It consists, as shown in Figs. 57 and 58, of weights suspended in such a way that they are free to move in all directions. Twenty-two of these weights are arranged in a row and are connected together by rubber bands. Each weight is suspended from a yoke and an equal weight is hung on the other side of the yoke to serve as a counterweight. A screen is set up to hide the counterweights and to avoid confusion in

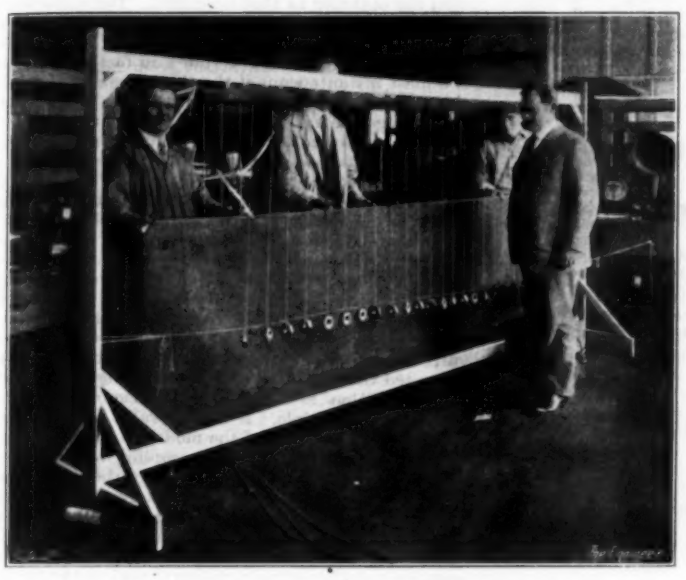


FIG. 57—MODEL FOR STUDYING THE POLARISATION OF WAVES

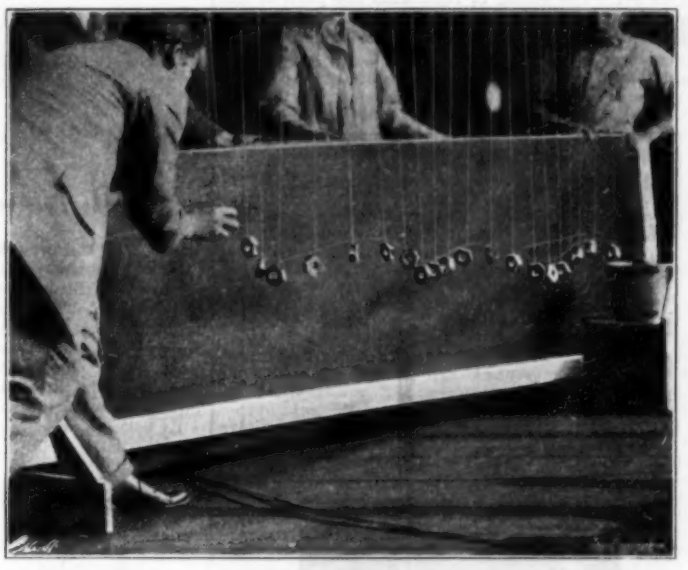


FIG. 58—MODEL SHOWING HOW A VERTICAL WAVE CHANGES INTO A SPIRAL

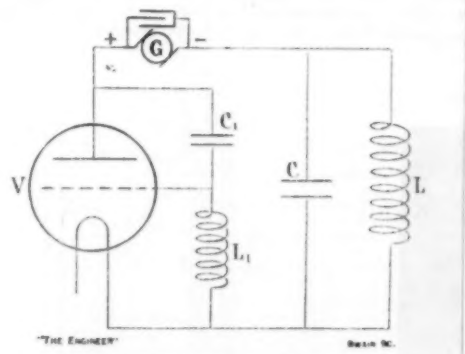


FIG. 59—OSCILLATING VALVE CIRCUIT

observing the wave motion. The model was designed especially to study the twisting of the plane of polarisation, and the experiment is said to have confirmed the theory it was intended to illustrate. It has been assumed that the medium through which the wireless waves pass has such characteristics that the velocity of propagation for a vertically polarised wave differs slightly from the velocity of the propagation for a horizontally polarised wave. It may be assumed that this is due to electrostatic and magnetic effects, to the retarding effect of the velocity of the vertically polarised wave passing close to the earth, or, on the other hand, to the properties of free electrons in the upper atmosphere. The actual cause does not, however, greatly concern us here. On both sides of the

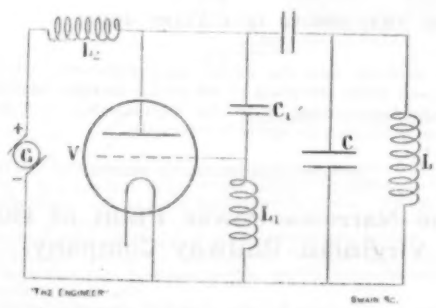


FIG. 60—"SHUNT" METHOD OF EXCITING ANODE

shape of a corkscrew. The straight line oscillation of the first weight is passed along as an elliptical motion, which gradually widens into a circle. This circle then narrows down again to an ellipse, and finally a straight line at right angles to the original line of oscillation. This is exactly in accordance with the theory, the point where the wave has shifted its plane of polarisation being the point where the faster of the two waves is half a wave length ahead of the slower wave. From this point on the wave proceeds to repeat this peculiar corkscrew motion. The fact that the twisting of the wave is due to the different velocities in the two planes of polarisation can also be demonstrated by this model. For this purpose rubber bands are added to the counterweights, the effect being to change the velocity of propagation in the vertical plane, whereas the velocity in the horizontal plane is not affected, because only the vertical motion is transmitted to the counterweights by the suspension yokes.

The system can thus be adjusted so that the velocities in the horizontal and the vertical planes are exactly equal, and after this has been done it is found that the corkscrew motion disappears and the wave remains strictly in the plane in which it was started.

While this mechanical experiment does not reveal any facts that were not known from the classical theory of wave motion, it is of assistance in visualising the main phenomena in wireless wave propagation which the engineers of the American General Electric Company have been trying to explain. The phenomenon of a constantly shifting plane of polarisation, which was discovered experimentally in tests between Schenectady and Long Island, can now be accounted for. This conception of wave motion is also a help in explaining the phenomena of fading, because there is experimental evidence which shows that fading is a phenomenon of interference. In other words, fading is apparently due to the fact that the waves arrive at a certain point through two paths. Sometimes the waves are added to each other, whilst on other occasions they neutralise each other. If it be remembered that on the mechanical model the waves in the two planes can be traced through separately and distinctly, it may be concluded that the two paths of the wave which produce fading are not necessarily two separate physical paths, but may be the two paths in the horizontal and the vertical plane of polarisation. For further illustration of this a detector may be introduced into the model.

If a detector be placed at a certain distance from the origin of the waves it is found that it gives no response when the system is adjusted for different velocities of propagation, whereas it gives a maximum response when the system is adjusted for equal velocity in the horizontal and vertical planes. Fading has thus been reproduced mechanically through polarisation in a single wave path. It is not suggested, however, that this mechanical equivalent is sufficient to explain the fading in actual wireless transmission, but it is put forward as a help to the interpretation of many observations in wireless transmission.

A dynamic model of a valve and oscillating circuit is described in a paper read before the Institution of

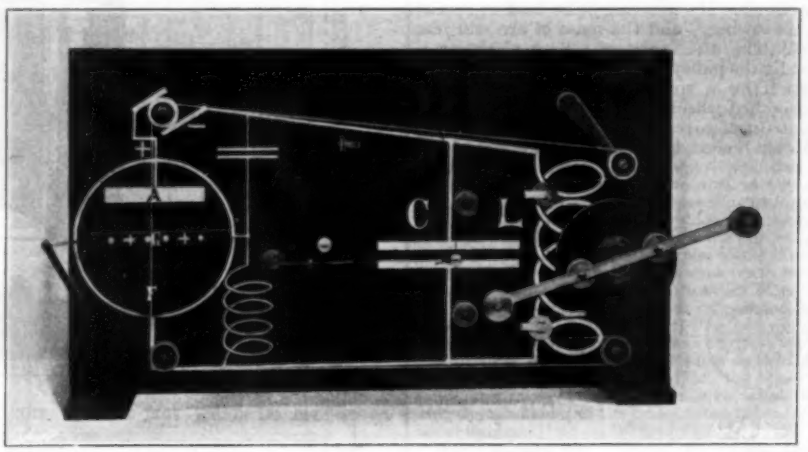


FIG. 61—OSCILLATING VALVE MODEL

Electrical Engineers by Mr. R. C. Clinker, of the British Thomson-Houston Company. The model is the result of an attempt to produce a mechanical system which will demonstrate the action of a three-electrode valve in keeping an electrical circuit in continuous oscillation, the model being intended to represent as closely as possible the well-known circuit shown in Fig. 59, where C and L represent the capacity and inductance of the oscillating circuit and G the source of power. The grid of the valve is capacity coupled, and it will be noted that in this circuit the current carried by the coil L includes a direct-current component, which passes between the anode and filament of the valve. The two components may be separated by the shunt method of exciting the anode, as shown in Fig. 60, where the main inductance only carries the alternating current, and although in some respects it would have been preferable to have made the model represent the arrangement in Fig. 60, the complications necessary to imitate the inductance L 2

* No. VI. appeared September 17th.

rendered it advisable to adhere to the more simple circuit shown in Fig. 59.

The base board of the model—see Figs. 61 and 62—is dead black and a diagram of the circuit is painted upon it, the various parts of the latter being marked underneath the mechanical parts. In Fig. 63 a flexible string S_1 is led round the pulleys 1, 2, 3, 4, 5, 6, and 7, of which 3 and 5 are floating, whilst the remainder are pivoted on the base board. The pulley 4 is of large diameter and its mass, together with the weights W fixed to it, represents the inductance L in Fig. 59. By removing or adding weights the frequency is varied. The string S_1 represents the path of the anode current and its motion, the motion of the electrons through the valve and oscillating circuit. It passes up in front of the valve V, the anode, grid and filament of which are represented in relief by

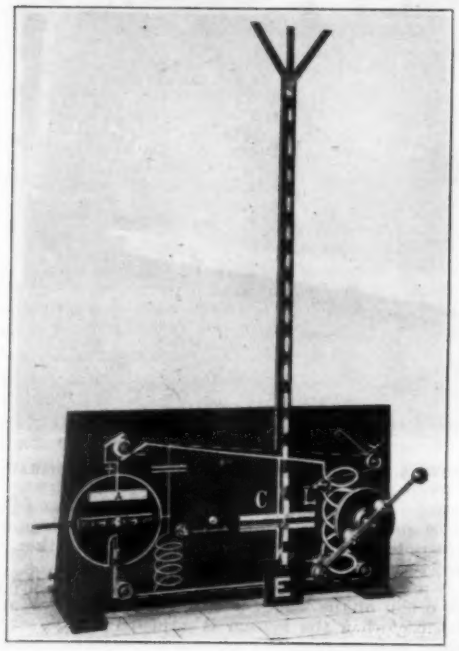


FIG. 62—OSCILLATING VALVE MODEL WITH AERIAL

pieces of wood. Another string S_2, which passes round the fixed pulleys 8 and 9, joins the centres of the pulleys 3 and 5. The "condenser" C consists of a flat spring fixed rigidly at D and attached to the string S_2 at E. Thus it will be seen that the oscillating circuit consists of the mass M, the spring C, and the four pulleys 3, 5, 8, and 9. In order to reduce friction these four pulleys and the mass M are mounted on ball bearings so as to keep down the resistance of the oscillating circuit. If the string S_1 be held at rest at the valve the spring C and the mass M are still free to oscillate. The direct-current source of power is represented by the pulley 1, which is driven in a clockwise direction by a small motor behind the base board. A toothed wheel on the shaft of the pulley 1 drives a centrifugal governor of the gramophone type, and the friction brake which controls the speed of this

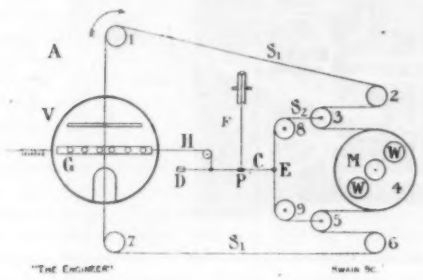


FIG. 63—DETAILS OF OSCILLATING VALVE MODEL

governor is operated by a thread F which is attached to a point P on the spring condenser C and passes over a pulley and through the base board, at the back of which it is attached to the governor. This thread forms the coupling between the grid and the oscillating circuit, and the coupling is varied by sliding P along C. Matters are arranged so that a downward motion of C, i.e., a counter-clockwise rotation of M, draws the brake off the governor and increases the speed of the string S_1.

The actual grid is represented by a sliding metal strip G, which is perforated and attached by a thread H to the spring C. A downward motion of C draws the grid G to the right and uncovers a series of white spots and plus signs, thus representing the grid as "open" or positively charged, whilst an upward motion of C uncovers a series of minus signs, representing negative electrification.

When the motor is started suddenly the string S_1 commences to move, but the mass M cannot start instantly and its lag causes the spring C to be drawn downwards, thereby displacing the pulleys 3 and 5 to the left and right respectively. This action applies an accelerating torque to the mass M and also increases the speed of the string S_1 to a maximum by releasing the governor brake.

During this time the mass M gains speed and E returns towards the centre. When this occurs, however, the mass M has a greater peripheral speed than the pulley 1, the speed of which having been further

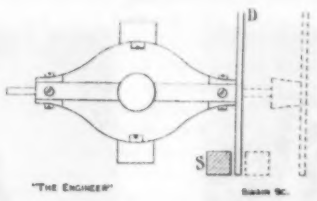


FIG. 64—FRICTION GOVERNOR MECHANISM

lessened by the upward motion of E. Consequently E overshoots the central point and in doing so applies the brake to the maximum extent and stops the pulley 1 altogether. The spring C then returns to the centre again, thereby starting pulley 1, and the operation is repeated, or, in other words, continuous oscillation is maintained. The string moves forward in a series of jumps and the pulley 4 exhibits an oscillatory motion superposed on a unidirectional one.

By releasing a set screw holding the pulley 1 to its

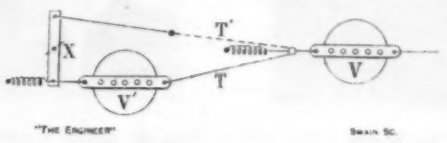


FIG. 65—ARRANGEMENT FOR DEMONSTRATING THE NEUTRODYNE PRINCIPLE

shaft the string may be freely moved by hand, and several experiments described by Professor Jenkin* may be repeated:—(1) On applying a low-frequency motion the pulley 4 oscillates, but the spring C is not appreciably stressed, and this represents the passage of a low-frequency current through the inductance only. (2) A high-frequency motion passes through almost entirely by means of the spring C; that is to say, a high-frequency current passes through the condenser only. (3) Slowly reducing the frequency until the motions of the spring and mass are equal demonstrates resonance. A small motion of the hand produces a large motion of the spring and mass. In the last case it is interesting to note how much tension has to be put upon the string, this being an excellent illustration of the fact that the impedance of a parallel combination of inductance and capacity is very high at the resonant frequency if the resistance be low.

If L, C, and R be the three constants, then the impedance at the resonant frequency is closely equal to L/(C R) ohms and the combination acts as a resistance having this value. It can also be seen that the phases of the currents carried by the condenser and coil are nearly in quadrature with their resultant, the external circuit, for careful observation indicates that the maximum velocity of the string through the valve, corresponding to maximum anode current, occurs at the zero of oscillation velocity or main oscillating current.

Many illustrations in the mechanical field can be given as analogies of the "negative resistance" properties of a coupled three-electrode valve, one of which is provided by the well-known friction governor mechanism as shown in Fig. 64. When the governor is rotated the disc D is drawn along the shaft towards the left hand, and if it touches the stop S a constant speed of rotation is reached, because a small increase of speed greatly increases the friction, whilst a small decrease greatly decreases the friction, this resulting in dynamic stability. If, however, a stop be placed on the right-hand side and it be moved slowly towards the disc until it lightly touches, the effect is then the opposite to that described. The slight friction retards the motion, reduces the centrifugal force and increases the pressure, thus causing cumulative action which stops the governor; in fact, the action is almost instantaneous if the stop S be rigidly held, the result then being dynamic instability, and it illustrates negative resistance. With such an arrangement it is easy to produce continuous oscillation if the stop is attached to an oscillatory system.

The illustration, Fig. 62, of Mr. Clinker's oscillating valve model shows the aerial in the form of a long coiled spring attached to the spring which represents the main condenser. The movement of this spring represents the current in the "aerial," which is zero at the top and maximum at the bottom. The line of the spring is continued to earth by a strip which slides in and out of a slot behind the earth plate E.

Mr. G. G. Blake, who is also the inventor of a valve model which we shall presently describe, has suggested that Mr. Clinker's model might with a very slight addition also be used to demonstrate the Neutrodyne principle. A second valve V_1 might be coupled to the valve V of the model, as shown in Fig. 65, to represent the capacity coupling between two circuits due to the internal capacity of the valve, and this coupling could then be neutralised by the addition of a second elastic thread T^1 acting in opposite phase by means of a pivoted arm X. Another method of illustrating the Neutroydne principle would be to negative the effect of the coupling thread on the model itself, so as to neutralise the coupling between the plate and grid circuits.

Another model designed by Mr. Clinker is intended to show the phases of the electromotive force induced in the two sides of a frame aerial when cut by the travelling electro-magnetic field of a wave, the motion of the wave being represented by a wooden slider cut in the shape of a sine wave, as shown in Fig. 66. The distance apart of the vertical sliders can be varied by placing them in different positions between different pairs of sheaves, which are mounted on the vertical board, so that they can be placed either close together, as shown, or 90 deg. or 180 deg. apart. By utilising a double sheave they can also be placed in front of

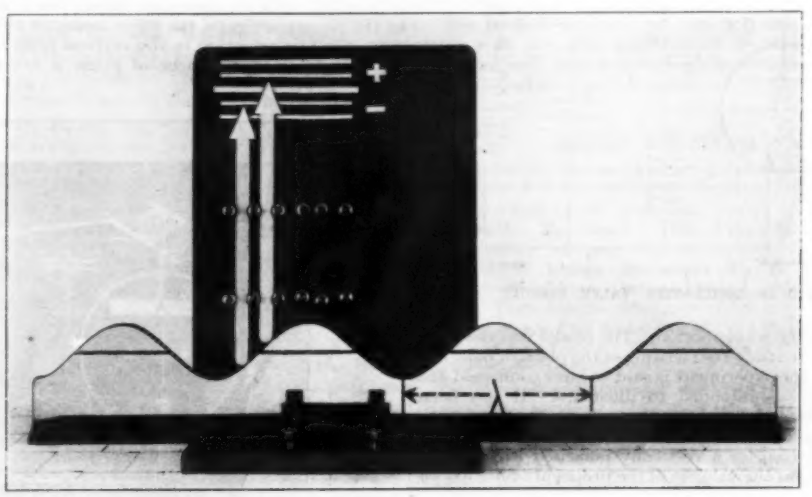


FIG. 66—MODEL FOR SHOWING THE PHASES OF THE E.M.F. INDUCED IN A FRAME AERIAL

one another, and the model then represents what happens when the plain of the coil is at right angles to the line joining it to the transmitting station, when, of course, no signal is received.

* See the *Journal* of the Institution of Electrical Engineers, Vol. 60, No. 312.

The Narrows Power Plant of the Virginian Railway Company.

No. I.

THE power plant for the electrical operation of the Virginian Railway was designed and erected by Messrs. Gibbs and Hill, of New York, under the general supervision of Mr. H. Fernstrom, chief engineer of the railway, and Mr. Hugh Pattison, engineer of electric traction. We are indebted to Messrs. Gibbs and Hill for the following account of this important undertaking.

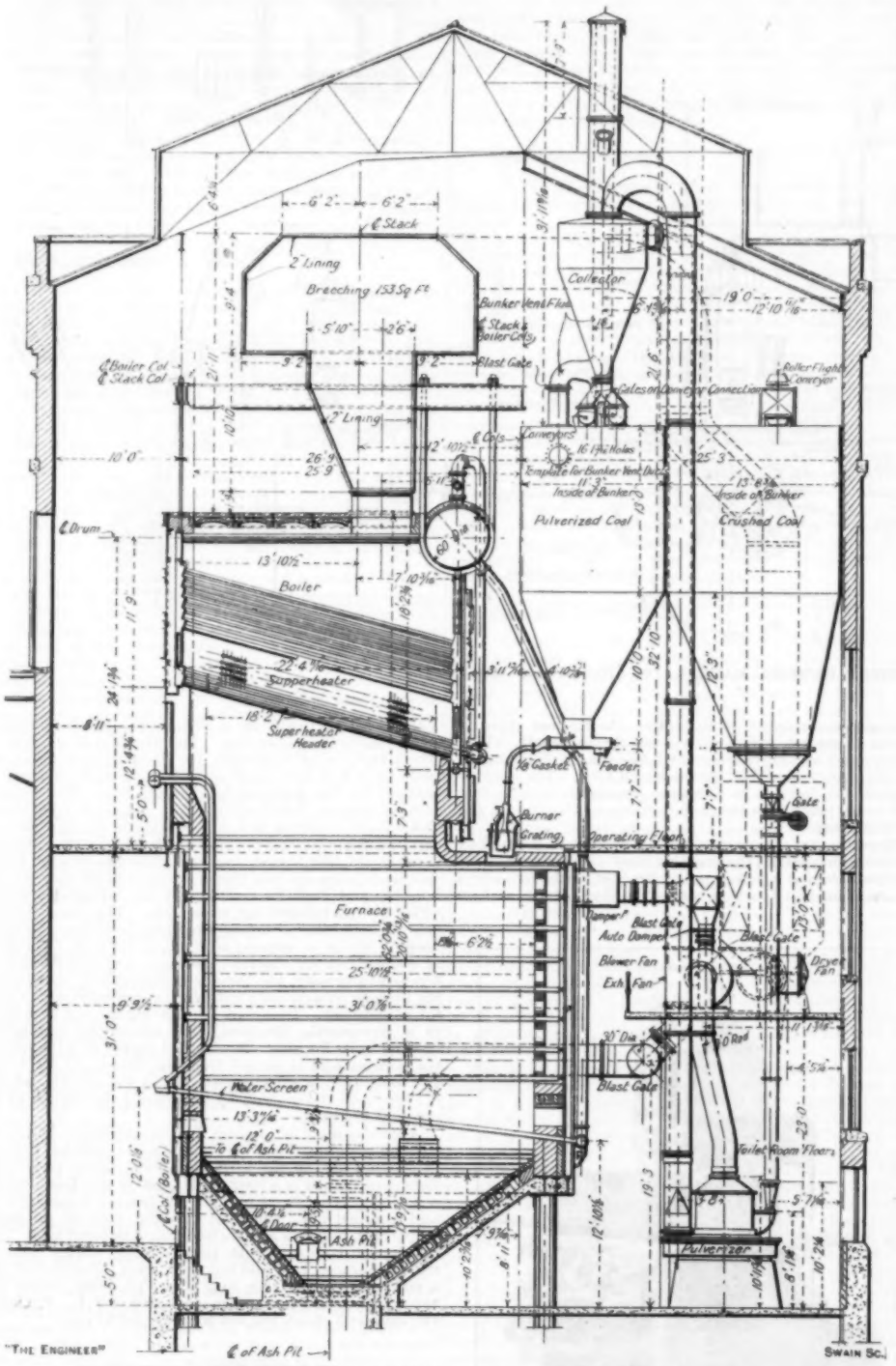
The electric haulage of coal trains, recently inaugurated by the Virginian Railway company, constitutes, in respect to size of train unit operated over adverse gradients, the heaviest concentration of power on a moving train ever undertaken. The electrification extends from

Mullens, W. Va., to Roanoke, Va., a distance of 134 miles, and includes the heavy gradient portion of the railway where it crosses the Appalachian Mountain system.

The maximum yearly tonnage for which apparatus is installed is 12,500,000 tons of coal, or 17,500,000 gross tons—cars and lading eastbound, with a small additional amount of manifest tonnage. The system is laid out to take care of a maximum day's traffic of 60 per cent. above the average day.

A steam power plant has been built for this operation on the New River at Narrows, Va. The selection of site was determined by considerations of an adequate supply of condensing water, nearness to centre of gravity of load, suitability of the location from the physical standpoint, and convenience for housing the operating forces in an established community.

It contains four three-phase, 11,000-volt, 25-cycle, turbo-generator units, having a continuous rating of 10,000 kilovolts at 80 per cent. power factor, with five 1521 horse-power cross drum boilers, equipped to burn pulverised fuel, as more fully described later. The power house is designed to permit of extension ultimately to include seven turbo-generator units and nine boilers. The generator voltage is stepped up through four 10,000-kilovolt-ampère transformers to 88,000 volts for single-phase transmission.



NARROWS POWER STATION—SECTION THROUGH BOILER

Power Plant Building.

The power plant building is constructed of brick and concrete with structural steel columns and floor beams, and with roof of special heat-insulating concrete slabs covered with zinc shingles. The boiler-room is 217ft. long, 62ft. wide and 91ft. in height, giving room for six boilers, five of which are installed. The boiler ash pits, pulverising mills and feed-water heaters are located at ground level. A mezzanine gallery, 23ft. above the lower floor, provides space for the pulveriser exhausters, the feeder blower fans and future coal-drying units. The main operating floor is 36ft. above the lower floor. A mezzanine gallery runs at the rear of the boilers, 12ft. above the main operating floor, and provides access to the rear of the boilers for the removal and replacement of tubes. The ground area occupied by the boiler house building is 13,500 square feet, or 1·48 square feet per boiler horse-power, and 0·34 square feet per kilowatt of generator rating. The boiler house contains 32,800 square feet floor area, or 3·6 square feet per boiler horse-power and 0·82 square feet per kilowatt—all allowances, including space required for the pulverising units, as well as that required by the boilers.

The floor area of the turbine-room is 11,500 square feet, thus providing 0·29 square foot per kilowatt.

The electrical bay has two floors above the ground level and provides space for the high-tension bus and switch gallery, the switchboard control gallery, a machine shop, tool-room, storage battery-room, toilets, and administrative offices.

A basement under the turbine-room and electrical bay, 32ft. below the ground floor, provides space for condensers, circulating pumps, condensate pumps, boiler feed pumps, house service pumps, filtration plant, and storage space for plant supplies. A mezzanine gallery, 18ft. below the ground floor provides space for possible future reactance coils for the main turbo-generators and for a 440-volt switch gallery.

Foundations.—The turbine-room basement floor is only 3ft. above low water level, and records show a flood stage of 33ft. above the basement floor. To provide for this hydrostatic head, very substantial walls and floor are provided in the turbine-room basement, the walls being of reinforced concrete 2ft. 9in. thick with dove-tailed construction joints. The horizontal reaction at the top of walls against the hydrostatic head is obtained by bearing against the heavy slab of the turbine room floor.

To provide anchorage for the floor slab against the hydrostatic pressure, it is reinforced and spans across between heavy concrete ribs, running between piers of the turbine foundations, against which they are expected to react upward.

The turbine bed plates are supported on steel girders and columns filled with concrete, which rest upon concrete piers 15ft. below the turbine floor, the piers running down to rock a few feet below the basement floor, and being braced by concrete walls. The steel turbine foundations are framed solidly into the floor framing, and strutted to each other by floor girders in order to develop the inertia of the heavy floor slabs as a steadying influence upon the turbines.

Stacks.—Two stacks are provided. They are of reinforced concrete, and are carried on and directly bonded into concrete mats at the roof of the boiler room. Each stack is supported by four steel columns, which also serve as boiler columns, and are wind braced to adjacent boiler columns by flexible members, permitting sway of the column supports which are cut loose from the roof framing. The columns rest on concrete piers which, in turn, rest on large concrete mats. The stacks are 25ft. 8in. outside diameter at the bottom, and 16ft. inside diameter at the top, and rise 285ft. above the concrete footings, making a total height of 376ft. above the bottom of the ashpit.

Coal-handling and Pulverised Fuel Plants.

The plant has been designed for the use of "bone" coal, with provision for burning the high-grade bituminous coal from the mines served by the Virginian Railway Company, or a mixture of the two. It is expected that the total annual net output of the plant will be approximately 120,000,000 kilowatt hours, and that the average daily fuel consumption will be approximately 390 tons of "bone" coal, or 275 tons of high-grade bituminous or 320 tons of a 50 per cent. mixture.

A coal siding is provided for storage of twenty-five to thirty cars leading to a track hopper, which will receive coal either directly from cars, or from outside storage by use of a power hoe. Coal passes from the hopper through a reciprocating feeder on to an inclined belt conveyor and over a magnetic pulley into a crusher, and thence into a hopper fitted with an automatic skip loading device and hoist which elevates the crushed coal and discharges it into a hopper at the top of the building, whence it is delivered either into a flight conveyor distributing the coal to six bunkers, or into a chute leading to outside storage.

The coal-handling equipment is designed for a capacity of 85 tons of coal per hour.

Steel pipe spouts convey the crushed coal from the bunkers into pulverising mills on the lower boiler-room floor 68ft. below the top of the bunkers. These mills are of the impact type and operate on the air separation principle, each mill having an air separator, a cast iron exhauster, a cyclone dust collector, and steel coal and air conveying pipes, which connect the mills, exhauster and collectors into a dust-tight system. Each mill is equipped with a pneumatic feed control which regulates the supply, and each unit has a relief pipe through the roof, fitted with an explosion door, and also a vent pipe leading to atmosphere through a water spray and collection chamber, arranged to prevent any coal dust from passing out of the system.

Two screw conveyors are installed between the dust collectors and the pulverised coal bunkers, so arranged that pulverised coal may be delivered from any pulverising unit into its bunker without operating the conveyors, or from any pulverising unit into any of the bunkers by the use of either or both of the conveyors.

Each pulverised coal bunker is vented. The coal conveying pipe, dust collectors, the vent pipe from bunkers and the sides, ends and tapering bottoms of the bunkers are insulated with magnesia blocks to prevent condensation. All parts of the equipment are electrically interlocked so as to ensure proper functioning.

Boilers, Superheaters, Boiler Settings and Firing Facilities.

The boilers are of the cross-drum horizontal water-tube type, for 325 lb. pressure. They are arranged in a single row, with independent settings extending from the lower boiler-room floor upward 62ft. to the top of the boilers. The boilers, superheaters, and pulverised fuel firing facilities are situated from 40ft. to 62ft. above the lower boiler-room floor. An operating gallery has been provided, 36ft. above this lower floor, so arranged that the staff has complete control of the boiler operation from one level. Each boiler has 15,210 square feet of heating surface and is built in twenty-four sections, each section being provided with two sets of tube headers at each end, the lower set containing the first four rows of tubes, the upper set the remaining fourteen rows, thus providing a double-deck construction, giving a clear vertical space for the superheaters. Baffles are so fitted as to expose the lower six tubes to the radiant heat from the fire and furnace walls, and cause the furnace gases to make three passes over the remainder of the boiler tubes before reaching the boiler uptake.

Water screens are provided to prevent formation of slag and to allow operation with high CO_2 content of furnace gases. The water screen tubes are exposed to direct radiation from all parts of the furnace and an absorption of from 30,000 to 50,000 B.Th.U. per square foot of surface is expected.

The superheaters are of the inter-deck design and each of them has 1770 square feet of heating surface. They give 150 deg. of superheat when the boilers are operating at 160 per cent. of rating. With the superheaters in this position they are exposed to the combined action of radiant heat from the fire and convection heat from the gases, resulting in a uniform superheat.

The boilers, superheaters and water screens are enclosed in a brick setting extending from the lower boiler-room floor to the top of the boilers. The lower portion forms an ashpit, the intermediate portion to the underside of the boiler tubes a furnace or combustion chamber, and the upper portion closes in the boilers and superheaters.

The pulverised fuel is introduced into the furnaces by a screw feeder to ten burners so mounted as to feed the coal vertically into the boiler at the top of the furnace. Air at a pressure of 15in. of water is admitted at the feeder outlet, and commingling with the coal carries the finely divided particles forward, imparting to them sufficient velocity to project the flame to the bottom of the furnace. The passage of the mixture of coal and air from the boiler

nozzle sets up an induced draught which draws in sufficient air around the burners to support ignition at the burner nozzle. The air thus introduced forms but a small portion of the total air for combustion, the balance being induced by natural draught through the air inlets at the front of the furnace at right angles to the vertical stream of coal, and so arranged and regulated as to enable each particle of coal to come into contact with sufficient air for its combustion. The result of this method of firing is a flame which travels downward until the lower zone of the furnace is reached, at which point the downward velocity is lost, and the flame doubles back on itself and flows upward at the rear of the furnace to the boiler heating surface, thus traversing in all some 50ft. and allowing sufficient time for complete combustion to take place in the furnace proper. The pulverised fuel equipment is illustrated on page 336.

Ash Handling.—The refuse resulting from the combustion of pulverised fuel is by reason of the cooling action of the water screens a finely divided granular ash. This refuse is carried away from the boiler by a sluiceway into the river.

Boiler Accessores.—In addition to the usual safety valves, water columns, blow-off valves, gauges, &c., each boiler is equipped with a feed-water regulator designed to retard the flow of water into the boiler on sudden increase of load until conditions are equalised, after which the feed water is fed at the rate of steam flow. These regulators have an indicating device so that the operator on the boiler-room floor may determine if the regulator valve is acting properly. A soot blower system is also fitted.

Combustion Control System.—A control has been installed for regulating the supply of fuel and air for varying loads, consisting of a master switch actuated by steam pressure in the saturated boiler header, fitted with a recording gauge to register the variations in boiler header pressure and with a motor-driven electrical contactor so arranged as to send electrical impulses to the control equipment, and designed to increase the flow of air and coal on a drooping pressure and to increase it on a rising pressure.

A central control panel bears a master contactor and drum switches so arranged that the master contactor may be by-passed and the variation of the coal and air fed to the boiler taken care of by hand push button operation. It also carries a meter for each boiler which records the flow of air through the boiler, the steam flow from the boiler, the temperature of the exit gas, and the speed of the feeder drives. Other gauges show the draught at the boiler uptake, in the furnace, and in the manifold header supplying primary air; the steam pressure in the saturated header and the pressure in the main steam header in the turbine room basement. On this panel are also mounted the switches and other apparatus necessary for the control of the circuits between the control board and the control boxes at the boilers.

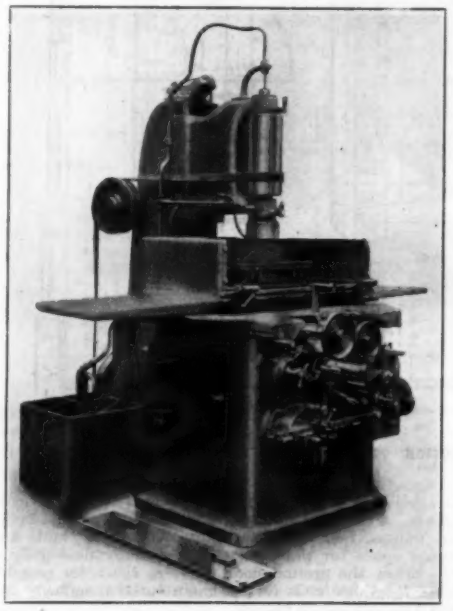
Boiler No. 1 is equipped with a steam flow air flow contactor, so arranged that when the steam flow-air flow relation is not correct contacts are made which readjust the position of the boiler uptake damper so as to change the air flow to correspond with the amount of fuel being fed to the boiler. The readjustment of air flow to steam flow on the remaining boilers is provided by manual operation of the individual boiler drum switches as indicated by the relative location of the steam flow and the air flow pointers on the boiler meter. The system is mechanically and electrically interlocked to render the operation safe.

THE cable ship Dominia has left the Greenwich works of the Telegraph Construction and Maintenance Company with the longest submarine cable in existence on board. It is to connect Vancouver with Fanning Island, a distance of 3500 nautical miles. It weighs 8500 tons, and will be laid at the rate of 200 miles a day.

Vertical Spindle Surface Grinding Machine.

THE grinding machine illustrated herewith has recently been built by Beyer, Peacock and Co., Ltd., Manchester, for tool-room work, such as the finishing of templates, gauges, &c., and the grinding of small details. It accommodates work up to 24in. long, 12in. wide, and 10in. high. The machine has a pedestal with a base 4ft. 4in. by 3ft. 1in., strongly ribbed to withstand reversal stresses. The pedestal is provided with a door for the tool cupboard and also inspection doors at the sides. At its rear there is bolted a bracket which carries the driving shaft, which is mounted in ball bearings and has the driving pulleys for the spindle and feed drives keyed to it. The drive is transmitted from a ball bearing countershaft with fast and loose pulleys to the pulley fixed to the end of the driving shaft.

Upon the pedestal is mounted an upright of strong box section which carries the grinding head. At the rear of the upright is bolted a jockey pulley bracket, with the pulleys mounted on ball bearings carried by fixed studs, and on the front of the upright is a vertical traverse screw supported by double ball thrust washers fixed in a dustproof housing.

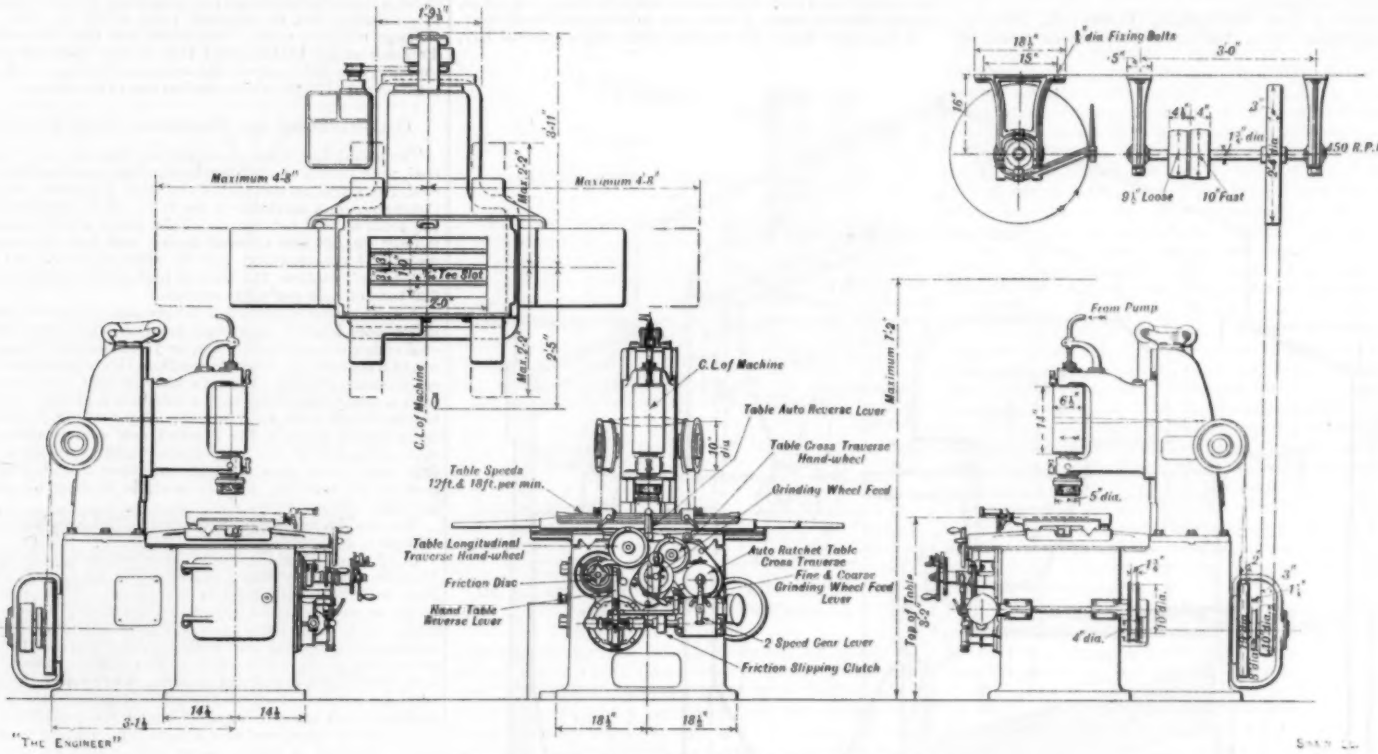


SURFACE GRINDING MACHINE

The table and slides are arranged with vee and flat guiding surfaces fitted with oil rollers, and are provided with automatic longitudinal traverse and intermittent cross traverse motions. These motions can also be controlled by hand from the front of the machine. The drive to the table is taken from a side driving shaft through a pair of bevel wheels and a two-speed gear-box providing table speeds of 12ft. and 18ft. per minute. Connection between the gear-box and a reversing box is provided by means of a friction slipping clutch and the drive is taken by gearing to a rack bolted to the underside of the table. Adjustable stops on the front of the table operate the reversing lever. The stops are arranged so that they may travel past the lever without the setting being altered. The intermittent cross traverse is operated by a shaft driven from the table gearing and connecting, by means of an adjustable friction plate, with a feed disc which oscillates a connecting-rod attached to a ratchet lever. Movement of this ratchet lever is transmitted to the screw by the ratchet wheel keyed to it and feeds up to ¼in. can be obtained.

The grinding head mounted on the front of the upright is traversed vertically by a micrometer handle arranged for fine and coarse traverses. The fine feed is indexed to give a traverse of 0·00025in. per division, and the coarse feed one of five and a-half times this amount. Carried in bearings on the grinding head is the hard steel spindle, 1¾in. diameter, fitted with a 5in. diameter ring wheel. The spindle revolves in a ball bearing in the top housing and in a taper bearing in the lower housing. End pressure is taken on ball thrust washers, while the weight of the spindle is taken on ball thrust washers fitted into the top housing and held in position by an adjustable spring collar to compensate for expansion. The lower spindle bearing comprises a hard bronze taper bush fitting an outer housing which is recessed to form an oil well. The bush is screwed on its external diameter and the housing is screwed internally, the threads engaging with corresponding threads on a circular nut which is provided with means for adjustment. To adjust the bearing the nut is screwed in a downwards direction, this movement raising the bearing in its housing. A plentiful supply of oil is kept in the housing and is carried from the bottom to the top of the bearing by a spiral groove cut in the spindle, whence it returns to the oil well by means of holes drilled in the nut and housing.

A good supply of cooling fluid is carried to the wheel by a pipe leading down the spindle to the splasher situated in the end and to the work by a side supply pipe. The fluid is contained in a removable tank on which is mounted a powerful centrifugal pump. All gearing is machine cut and guarded and, wherever possible, runs in oil baths. Important bearings are enclosed by dustproof caps. The machine is complete with two grinding wheels, 5in. diameter, diamond tool and holder bracket, countershaft and a magnetic chuck, 19in. long and 7¾in. wide, fitted with taper adjustment and a demagnetising switch. Excluding the magnetic chuck the machine weighs 51 cwt.



SURFACE GRINDING MACHINE FOR TOOL-ROOM WORK

WHILE there are deposits of amber in the Nordic countries and in Rumania, Sicily, and Spain, Germany possesses the most commercially profitable deposits in the world. This branch of German industry produces raw or crude amber, chiefly, marketing it to refiners for the manufacture of smoker's articles and amber ornaments. Surface deposits occur above Koenigsberg, in East Prussia, on the so-called Samland coast on the Baltic Sea. Two coastal villages, Palmnicken and Kraxtepellen, lead in production. According to data collated by the United States Bureau of Foreign and Domestic Commerce, the German amber industry was acquired by the Prussian State in 1899. Since 1924 it has been operated by a company, which is the sole producer at present. The pre-war production of crude amber from surface "blue earth" on the Samland coast amounted to about 400 metric tons annually. During the war it dropped to only one-fifth of this amount. Since 1922 pre-war production has been exceeded. The installation of modern mining apparatus on the Palmnicken deposits permitted a production of 442 metric tons in 1924 and a production of 497 tons in 1925.

South African Engineering Notes.

Durban South African Railways Improvements.

DURBAN is to have a considerable expenditure on railway and harbour improvements; if all the items included in the construction estimates for the year ending March 31st, 1927, are carried out. The South African Railways and Harbours Administration has allocated to Durban £115,000 for shunting yards and signalling alterations at the Central Railway Station. New boiler repair shops and engine-erecting shops are proposed at a cost of £210,000. New tracks and sidings are in progress at Greyville Running sheds and Umgeni. At Congella a new marshalling yard is allowed for, as well as further sidings and lighting at Maydon Wharf. Twenty-two thousand pounds will be spent on reclamation work, including levelling, wharves, roads, and railway lines. Work will be continued on the deep water channel, 1000ft. wide, leading to the graving dock. At the Bluff nearly £26,000 of the total amount of £73,000 allocated to the new coal handling and storage plant is likely to be spent during the year, and a further £1800 is allowed for transporter track extensions, and £8500 to complete the belt conveyor plant additions. At the Point twenty electric luffing cranes are to be installed at a cost of nearly £112,000, as well as the balance of twenty electric capstans, £32,000 being estimated to be spent this year. Other items include a steel piling punt (£4000), an 80-ton floating crane, a sea-going hopper grab dredger, a new clay cutter for the dredger Oceanus, and a new mooring buoy.

Platinum Industry.

The platinum mining industry continues to expand, and its future to become more promising. At present three plants are at work—all "pilot" or experimental—with capacities varying from 700 tons to 1500 tons of ore monthly. The Onverwacht Mine is the richest so far discovered, the grade running about 11 dwts. to the ton, representing a value of £12 16s. per ton of ore crushed. As the recovery is under 80 per cent. as yet, the real grade of the rock is about 14 dwts., and it is anticipated that soon the process will be so improved, as the result of experience, that a recovery of nearly 90 per cent. will be obtained. The July result was 1560 tons milled and 849 dwts. of platinum and allied metals recovered, representing a yield of 10·9 dwts. per ton.

The plant at the Transvaal Platinum, Ltd., mine has been at work over two months, but, although the value of the ore as assayed runs about 8 dwt., the recovery has been very low, barely 2 dwts. per ton crushed. This is owing to the rock being entirely different from that on any of the other fields and very refractory. The mine is in the Waterberg district, and while the other mines are in norite and dunite formations, the Transvaal Platinum Company mine is in a lode which is best described as a quartz-impregnated fault zone. The platinum, it is stated, occurs in the native state, the only other minerals present being quartz, specularite, hematite, secondary iron oxide, a pale-green mica, a deep leek-green chromiferous chlorite and kaolin. This would not seem to offer great difficulty, but in practice the reverse is true, and although improvements and additions to the plant are being made from time to time, a process giving a satisfactory yield has not yet been announced as discovered, and the monthly output has only been a couple of hundred ounces or so. The metallurgists of the company are, however, quite confident of achieving success shortly, as the technical staffs of the great gold mining groups are all engaged on the problem.

The Dewars River plant of the Lydenburg Platinum Areas, Ltd., has now been at work nearly two months. Here the difficulty has been that the plant was got ready to work before the Government had proclaimed the farm—it is not yet proclaimed. The result has been that the company is only able to take ore from the discovery claims, which happen to represent ore of the lowest grade sections along the whole strike. However, in the time of waiting for the proclamation of the farm, the pilot plant is giving very valuable information on the treatment of dunite reef. Concentrates are being accumulated, and the first shipment will shortly be made to London for smelting and refining, after which the recovery will be made known.

The same company has three other important platinum farms on which it is mining on the Lydenburg field. These are situated close together, and the grade of ore is over 7 dwts. to the ton. A reduction plant has been erected on one of the farms, Maandagshoek, and the main power plant has been given a trial run and worked very satisfactorily, while work on the reduction plant is about finished. This plant will also crush for the two other farms—Mooihoek and Driekop—the ore being transported to the Maandagshoek plant by means of two aerial lines which have been completed. On Mooihoek the grade of ore runs high and is improving with depth; one shaft started at the surface with 7·5 dwts. per ton, which it averaged down to 70ft., after which it steadily rose and had reached 10·3 dwts. at 120ft., the average over the whole depth being 8·8 dwts. The plant will crush about 3000 tons monthly; it will start about the middle of September, and should give an output of about 1100 oz. per month.

Another company, the Eerstegeluk Platinum Company, Ltd., which has developed an enormous tonnage of ore giving from 5 dwts. up to 6·6 dwts., has nearly completed the installation of a crushing and reduction plant to deal with 5000 tons monthly. The plant comprises jaw crushers, rolls, supplemented possibly by disc crushers and three 6ft. by 22in. Hardinge mills. Electrical power for driving will be generated by steam. The exact details of the recovery process are yet to be determined, as a result of further experiments now in progress, but it is probable that galvano amalgamation will form part of the treatment.

Several other companies will probably be ready to start crushing and reduction this year, among them the Platinum Proprietary Company of Lydenburg, Ltd., which has a large tonnage of good grade ore developed, and hopes to be putting up its plant in September. Another good proposition is that of the Northern Platinum Exploration Company, though its average values run little, if anything, over 4 dwts., but the quantity of ore is large; then the Lydenburg Central Platinum Company, which is getting values of 8 dwts. up to 13 dwts. on its properties in the Middleburg district, will soon be erecting plant, and others that will follow will certainly include De Kroon Platinums, Ltd., in the Pretoria district. Some remarkable values have been obtained by this concern. A bulk sample of surface outcrop taken at various points and weighing 250 lb. was brought to Johannesburg and treated by a new process yielded a return of 62 dwts. per ton. The Central South African Lands and Mines, Ltd., has over 29,000 tons of payable ore blocked out and is considering a plant scheme. There are others which could be added to the list, but they will not be ready to crush this year. Finally, the Onverwacht may be mentioned as announcing that it will have doubled the capacity of its plant by the end of October. Altogether it is a conservative estimate to say that 1927 will open with the platinum industry giving an output of over 7500 oz. per month, or, say, a value of £175,000 monthly, being at the rate of over two millions annually; but, of course, with the other companies which will be producers early next year, among whom will be the Premier Rustenberg Company and others from the Rustenberg field, now fast proving itself about the most valuable of all, the opening production figures for 1927 will, in all probability, be close on to being doubled by the end of the year. After this it may be necessary to control outputs, if the price of £23 10s. now ruling for the metal is to be maintained.

Cape Electrification.

Three steamers arrived during July with thousands of tons of machinery and material for the electrification of the Cape Town Suburban Railway system, for which the new power station being built near the Salt River mouth is to supply the electric energy. The estimated total cost of the construction works, which involves the substitution of all passenger bridges at the station by subways and the duplication of the line from Muizenberg to Fish Hook, as well as the widening of all tracks to give 13ft. centres between adjacent pairs of rails, is £428,062, of which £100,000 is to be spent during the current year. The estimates, moreover, provide for 209 suburban coaches, the total cost of which will be approximately £814,866, and, in addition, 89 first-class suburban coaches are being imported at a cost of £384,219. The original intention to electrify also the lines to the docks for passenger service, has recently been abandoned in favour of the introduction of a motor transport service between the Adderley-street main and suburban passenger stations, and the docks, except for occasional trains run as at present at times when the density of the traffic is beyond the capacity of the motor service. It is hoped that the greater portion of the work will be completed in eighteen months from the present date.

Electrical Undertakings.

The new electricity undertaking embarked upon by the town of Ladybrand close upon two years ago has been completed, and the town is now lit up in a very satisfactory manner. Two small electricity schemes for the towns of Hopetown and Barkly East, have recently been approved by the Electricty Supply Commission. They are distinct departures from the conventional as regards the prime movers to be employed. Both schemes are alike, and call for some 30-kilowatt of output only, and the usual expectation was that oil or suction gas would be adopted for them. The consulting engineer has, however, recommended steam as definitely better both as regards capital amd maintenance costs. The Sentinel power unit already familiar on South African roads and railways is to be used. The unit, consisting of boiler with superheator, feed-heater, feed pump, engine and all accessories, forms a complete power plant of a simple kind, capable of being operated with little skilled attendance. The all-round fuel costs, water consumption, &c., are, it is stated, less than with the internal-combustion engine, and, in addition, two complete units, one being a standby, can, it is claimed, be purchased for about the same prices as a single internal combustion plant of equal output. A great advantage is that common steam coal may be used for steam raising.

The Town Council of Dordrecht has borrowed money from the South African Mutual Life Assurance Society for its new electric lighting scheme. At Tarkestad the ratepayers have unanimously authorised the Town Council to embark on an electric lighting scheme. The Council has agreed to grant free connections to the mains to the first seventy applicants. The Town Council of Fort Beaufort has received the final approval of the Administrator to its electric lighting scheme, and the Mayor of Sterkstroon has advised the Council that he will shortly lay before it proposals for an electric lighting scheme for discussion, and submission thereafter to the ratepayers for approval. Thanks to the fast-growing domestic load superimposed on an equally rapid increase in power demands, coupled with continual improvement in machinery and plant, generating costs at the Durban Municipal Power Station, during the month of May, 1926, reached a new record minimum of .296d. per unit delivered to mains, the total number of units supplied equalling 5,349,000, and the maximum load attained being 15,700 kilowatts.

The Salermo Process of Low-temperature Carbonisation.

THE following notes are taken from a pamphlet issued by Salermo, Ltd., of Imperial House, Kingsway, London, which discusses low-temperature carbonisation in general and the process invented by Mr. E. M. Salerni in particular.

The Salermo process employs externally heated retorts with continuous feed, the material heated undergoing continuous and regular stirring. The material to be carbonised is pre-dried by means of waste heat.

The retort consists of semi-cylindrical troughs of mild steel, a standard trough for carbonising non-caking coal being 10ft. long with a radius of 8in. For bituminous coals the radius is reduced to 5in. and the trough shortened. From eight to fourteen of these troughs are placed side by side under a common roof, thus making a single carbonising chamber or retort. Along and above each trough is a central shaft provided with stirring paddles fixed normally to the shaft. These paddles are placed close to each other, but in different planes. They can be made to revolve at any rate required and their action is threefold:—(1) To cause the material in the troughs to move along from trough to trough; (2) to keep it in constant motion, so that it behaves like an emulsion or a liquid; (3) to keep clean the inside metallic surfaces and so secure an efficient heat exchange. Each paddle terminates in a scraper whose function is to remove from the bottom and sides of the troughs any graphite, &c., which might tend to form. The scrapers are readily replaced when wear and tear make renewal necessary. The first trough is fed automatically and continuously from the pre-drying installation placed above the retorts.

The material, reduced to a suitable size which experience has shown to be about ¼in. maximum, is taken to a hopper by an elevator and fed on to a drying conveyor to a thickness of about 1in. The conveying system consists of two chains running alongside two superposed parallel fixed plates, the chains being connected transversely by metal rods at fixed intervals. The material passes at any desired rate along the first plate, and returns on the second and lower plate. The drying is done by the hot gases which have done their work in heating the retort.

To heat the retorts hot gases from any outside source or the gas evolved in the process or by means of solid fuel may be employed. The heating chamber is divided from the retort by a series of brick arches, so that no flames play directly on the retort. From the heating chamber the gases proceed through a by-pass and along the bottom of the troughs, which form what is really a corrugated retort. This is supported at the sides on brickwork. The last trough at the semi-coke exit end is heated by the hottest gases at a temperature of some 700 deg. Cent., and measurements have shown that the coal itself, which is in motion all the time and not left in contact with the hot metal, is at a temperature of not more than 500 deg. to 550 deg. Cent.

The carbonised material is discharged continuously from the last trough on to a cooling chain conveyor of the same type as the drier already mentioned. In this case there is fitted a system of cold-water pipes between two fixed plates, and when the semi-coke is discharged from the conveyor, it is perfectly dry and nearly pulverised, and at any temperature from 500 deg. Cent. downwards, as may be arranged for. If the cooling be omitted, the hot material can be used for the direct feeding of steam boilers, thus effecting a great economy in view of the dryness and temperature of the fuel.

The semi-coke as obtained from non-coking coals is in too small a form for domestic use without further treatment. Its main uses are for the direct firing of steam boilers.

At the Sarre mines the process has been working for nearly a year, and has been the subject of reports by M. J. Sainte-Claire Deville.* The two units erected deal daily with 25 tons of coal, which is very wet and of low density. A further installation to deal with 200–250 tons a day has been ordered. The object of the treatment in this case is to produce from poor coal a semi-coke of a definite volatile matter content to blend with a flaming coal which is not satisfactory for making the best grade of metallurgical coke.

BRITISH STANDARDS FOR ELECTRICAL MACHINERY.

THE British Engineering Standards Association has issued a revised edition of B.E.S.A. Publication No. 168, for the electrical performance of industrial electric motors and generators with Class A insulation. This specification was originally published in 1923, and forms part of the series of eight specifications which replace publication No. 72, 1917. The revision is mainly that of arrangement. In order to bring the British specification into the form recommended by the International Electro-technical Commission, the body of the specification contains only matter defining the performance of the machine on test at rated load.

Information regarding the service conditions under which the machine is suitable for operation at its rated load, and the sustained overloads permissible in service under various conditions of cooling air are given in a separate appendix. These permissible sustained overloads have been slightly rearranged in a more convenient form, and it is felt that the new edition should make this already serviceable specification yet more useful to both manufacturer and user.

Copies may be obtained from the B.E.S.A. Publications Department, 28, Victoria-street London, S.W. 1, price 1s. 2d. post free.

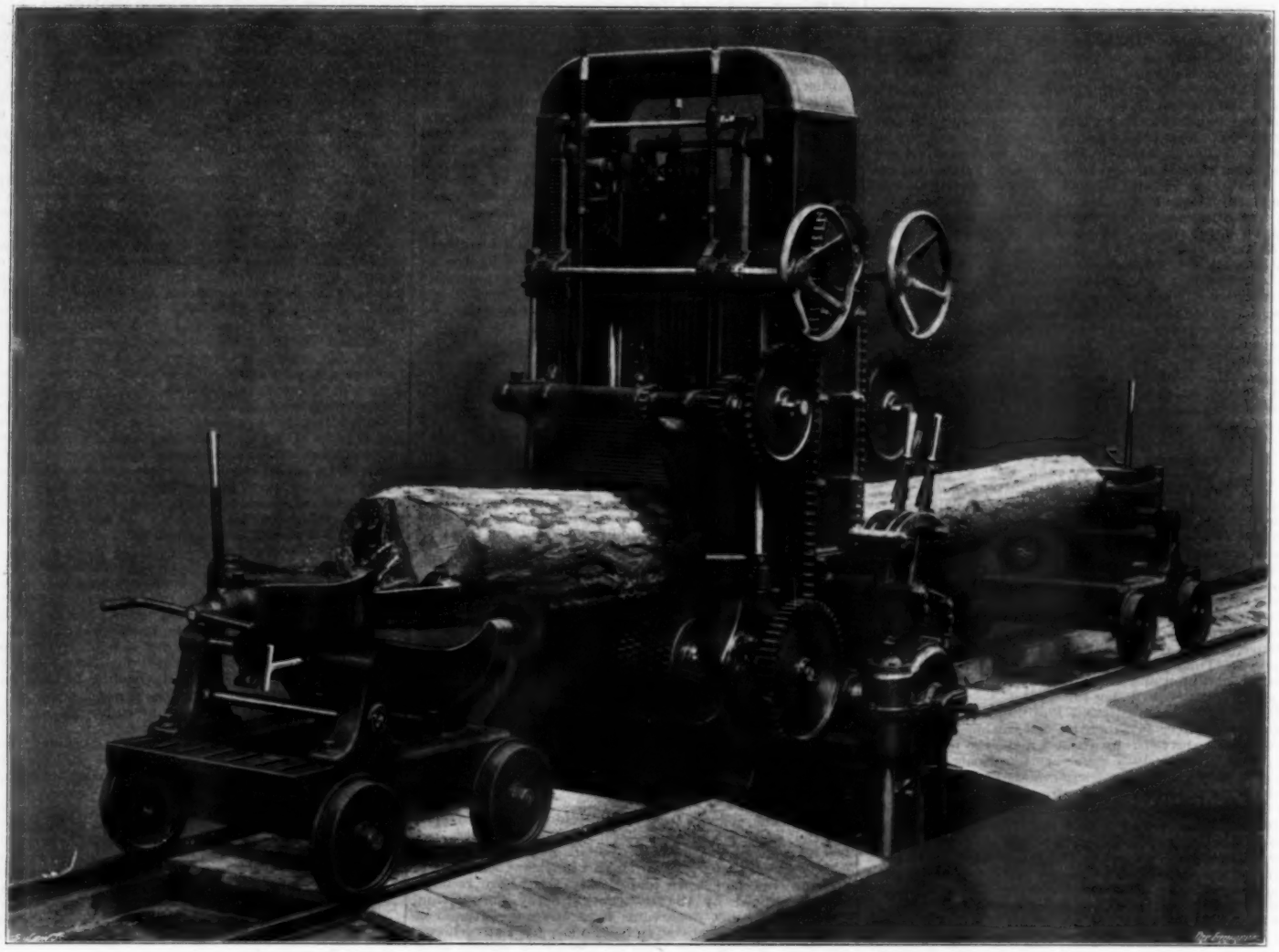
THERE is a rumour current in Berlin that the German Dye Trust is making good progress in its efforts to perfect a chemical process that will enable it to manufacture synthetic rubber. Much research work has been devoted to this problem by eminent chemists for several years past. As a matter of fact, they were engaged on this during the war, and the dye trust is giving great attention to the matter, in view of the very considerable commercial advantages that would accrue if success were achieved.

THE first of three giant Anec III. passenger aeroplanes which are to be placed on Australian air routes, arrived in Melbourne during July. It has accommodation for seven passengers, a maximum speed of 105 miles an hour in still air, and a petrol range of 450 miles. Equipped with large Rolls-Royce engines, which will be capable of developing 360 horse-power, these aircraft will have a span of 60ft. and a length of 45ft.—the largest aircraft in Australia.

* *Chimie et Industrie*, September, 1925, Vol. 14, and February, 1926, Vol. 15.

20-INCH HIGH-SPEED LOG FRAME

A. RANSOME AND CO., LTD., NEWARK-ON-TRENT, ENGINEERS



High-speed Log Frames.

A NEW type of high-speed log frame—known as Type 135—has recently been introduced by A. Ransome and Co., Ltd., of Newark-on-Trent. These machines—one of which is illustrated in the accompanying engraving—are specially designed to operate at high-feed speeds, all the reciprocating parts being constructed of special materials to enable high speeds to be maintained, with consequently large outputs.

The makers point out that these new frames are not only intended for cutting up soft wood logs in the countries where they are grown, but are well adapted for large daily outputs with imported soft wood logs, and that they may utilise pit props as material for box and packing case manufacture. It is claimed for the machines, too, that they are simple to operate, that the saws are easily and quickly changed, and that timber is saved, owing to the thin gauge saws which can be used.

The machine consists of massive bed-plate, with which is cast the crank shaft bearing housings, and to which also the main frame sides are bolted. These sides are heavily ribbed and are connected to each other by wide cross ties to insure that the slides for the reciprocating saw frame are rigidly supported. This is a matter of special importance, having regard to the high velocity of the moving parts necessary to permit the fast rate of cutting speeds available. The saw frame is built up of steel castings connected together by vertical weldless steel tubes, so as to give a light but strong construction.

At the feeding-out side of the machine, the saw frame moves in V slides, and at the feeding-in side, the slides are made flat and readily adjustable, so that any wear may be quickly taken up. At the lower end of the saw frame is held the connecting or gudgeon pin, which passes through the upper end of the connecting-rod. This pin can be easily removed and replaced, should it require truing-up. The connecting-rod is a steel forging, machined all over. It is of H section, such as is used on an express locomotive, so as to give great strength with a minimum of weight. The upper end, which encircles the connecting pin at the lower end of the saw frame, consists of an adjustable gun-metal bearing with a large wearing surface. The lower end forms the housing for the roller bearings on the crank pin. These bearings are of large proportions, and no wear can take place on the crank pin itself for their inner races surround it, and knocking and pounding of the reciprocating parts are therefore avoided.

The crank shaft is built up to permit the use of a separate crank pin to carry the inner races of the roller bearings of the large end of the connecting-rod and to enable them to be placed in position. The crank shaft bearing housings being cast in one with the bed-plate enable the shaft to be rigidly carried so that it may run freely without danger of heating. Roller bearings in dust-proof housings are used throughout, so that the quantity of lubricant required is small.

The crank webs are formed to carry balance weights to counterbalance the weight of the connecting-rod and the saw frame, so as to relieve the crank shaft of such stresses as would occur if the balancing were done by the fly-wheels, which are placed at each end of the crank shaft. The driving pulley and the loose pulley which revolves on ball bearings are placed at one end of the crank shaft, and at the other end is the two-speed pulley to drive the feed mechanism.

The feed rollers are four in number, the two lower ones being made up of a series of spiked discs, keyed side by side on a steel shaft, and driven by machine cut gearing. Provision is made to keep each lower spiked feed roller clear of bark, &c., by means of a series of pointed steel fingers, so placed that they come between the revolving discs comprising the rolls. The upper feed rolls have deep flutes and are driven by means of steel roller chains. Both upper and lower feed rollers on either side of the machine are mounted in a frame, which can readily be swung to one side, to give access to the saws and saw packings, for setting up and changing. Each of these roller carrier frames is held in the working position, by the movement of a single lever, which is also used to release the frame quickly when it is required to swing it to one side. Hand wheels, actuating steel machine-cut pinions and racks, allow the upper feed rollers to be quickly adjusted to suit logs of different diameters, after which they are so mounted and driven as to be self-adjusting through a wide range to suit tapered logs.

The feed gear is driven from one end of the crank shaft by means of a two-speed pulley driving by belt on to a cast iron disc wheel, which is normally pressed into contact with a sliding friction wheel. The use of the two-speed pulley, which can be readily removed and turned end for end, is to increase the range of the variable friction drive, and to obviate the necessity of running the friction wheel near to the centre of the driving disc, when a low range of feed speeds is required for heavy work. There is a foot pedal for moving the driving disc out of contact with the friction wheel so as instantly to stop the feed. The sliding friction wheel moves on a vertical shaft which operates the feed gearing through an enclosed worm and wheel, and this friction wheel is counterbalanced, so that the rate of cutting may be varied at any time whilst the log is being sawn, without effort, by means of a lever placed at the side of the machine. This same lever enables the direction of the feed to be reversed.

The belt shifting gear is controlled by an outside lever at the side of the machine, which moves the driving belt to start and stop the crank shaft, and when the belt is moved on to the loose pulley, an adjustable band brake automatically comes into operation on the face of one of the fly-wheels. This arrangement has been introduced because, without it, a considerable time would be required to bring the machine to rest, when it was necessary to change saws, owing to the ease with which all moving parts work.

This new type of machine is interesting as being the first of its particular kind to be manufactured in this country. Hitherto saw frames of this class have been built in Scandinavia, but the machine illustrated is of a more robust construction than are the Scandinavian machines. It is intended for dealing with logs up to approximately 20in. in diameter, but we gather that Messrs. Ransome are arranging to build larger sizes.

The Model Engineer Exhibition.

For some time past we have looked forward to the fulfilment of Mr. Marshall's promise that he would organise another Model Engineering Exhibition, and the show, at the Royal Horticultural Hall, Westminster, which closes on the 25th inst., is a good justification for our impatience. There are not, perhaps, quite so many trade exhibits as in the past, but the display of amateur work is one of the best we have seen.

To some people the making of models seems to be a waste of energy, but, as we have pointed out before, model making is one of the best of trainings for young engineers, and a very good example of its merits is given by the collection of models, included in the Exhibition, made by Mr. G. F. G. Desvignes. Mr. Desvignes, who is now some seventy-six years old, will be remembered as one of the pioneers of high-speed steam launches; but he started model building at King's College when about fourteen years old, and turned out, at that time, one engine a year on the average. Many of these early models are exhibited, together with photographs of his launches, such as the Hibernia, of 1897, which had a speed of 29 miles per hour, and some comparatively recent models that Mr. Desvignes still continues to make as a pastime. Mr. Desvignes certainly comes of a mechanical family, but there is no doubt that his early experience in model making must have helped him materially in achieving his later successes. Incidentally it is worth recalling that so long ago as 1866 he fitted the launch Calypso with a water-tube boiler working at a pressure of 180 lb. per square inch.

The modern racing model boat cannot truly be described as a model, as no one would dream of reproducing it on a larger scale, but it is, nevertheless, very interesting from a mechanical point of view, and gives another instance of the hard fight which the internal combustion engine must put up to oust the steam engine. For all the really fast models are steamers, although some petrol-driven boats are shown. Economy is not, of course, considered in the running of a model boat, but it really is remarkable that a little craft, about a yard long, can

accommodate machinery sufficiently powerful to drive her at a speed of 42 miles per hour.

Besides the models lent to the Exhibition, there are about 150 others, on show, entered for various competitions, and they include locomotives, complete trains, sailing ships, yachts, steamers, marine engines, petrol motors, mill engines, motor cars, aircraft and pumps. In the last mentioned class there is a specially meritorious example of a set of pumps to work in conjunction with a condenser, and there is a beautifully executed model, to the scale of ¾in. to 1ft. of a 6in. naval gun, but we will not attempt to give here a more detailed catalogue of the models. It is sufficient to say that there is ample evidence of a growing popularity for the pastime.

Among the trade exhibits there are, of course, a number of small lathes and light machines by familiar makers, such as Drummond Brothers, the Britannic Company, the Cheltenham Works, the Billing Tool Company, Exeter Tools, Buck and Ryan, Jones and Shipman, and Henry Milnes, but as these machines do not differ materially from similar exhibits at past shows, it is not necessary to enlarge upon them here.

There are, however, several more novel appliances, and among them may be mentioned a treadle-driven grinder, by W. Heyden, of Redruth, Cornwall, which is operated by a long screw and ball bearing nut; some universal and bending vices, by the Wren Tool Company, of Manor Park; and some very neat little polishing heads on Jones and Shipman's stand.

There is an innovation this year at the Exhibition in the form of a stand organised by the Royal Air Force School of Technical Training. It is under the charge of two officers, and shows the work carried out by the aircraft apprentices in the course of their three years' training at Halton Camp prior to becoming R.A.F. mechanics.

A NEW FERRY STEAMER FOR SOUTH AMERICA.

AT the Woolston Works of John I. Thornycroft and Co., Ltd., there was launched on Saturday, September 11th, the double-ended twin-screw ferry steamer which the firm has constructed for the Companhia Cantareira e Viacao Fluminense. The vessel will operate in Brazil, running between Rio de Janeiro and Nictheroy.

She is designed to carry 1300 passengers, and her principal dimensions are as follows:—Length overall, 183ft.; extra moulded breadth on main deck, 43ft.; moulded depth, 11ft. 4in.

The ferry is of the double-ended type, and is fitted with twin screws at each end, with four special well type balanced spade rudders, placed one immediately beyond each propeller. The ends of the vessel are of special design, similar to those fitted to the ferry vessels which were recently built by Thornycrofts for the Wallasey Corporation of Liverpool, which, we learn, have proved themselves very successful in service, both as regards ease of manœuvring and quickness in getting under way when departing from the piers.

There are main, upper or passenger deck, and shade decks, and the main deck is arranged for the discharging of passengers at either end.

Passengers are accommodated on the main deck in an enclosed steel deck-house, which is panelled in teak and is fitted with large opening windows. Deck seats are fitted on both the main and passenger decks. In view of the service this ferry will undertake, special precautions to ensure coolness have been taken, and all the windows are fitted with jalousies, so that passengers will not be exposed to the tropical sunshine.

The propelling machinery consists of four compound inverted direct-acting surface-condensing engines, coupled together in pairs with two lines of shafting, which extend the whole length of the vessel, two propellers being arranged at each end.

The total indicated horse-power of the engines is about 800, and the vessel is designed for a trial speed of 11½ knots. There are three boilers of the multitubular return tube type, each 9ft. 6in. in diameter, with a length of 10ft. 6in. They are constructed for a working pressure of 150 lb. per square inch.

The vessel is fitted with electric light, and current is provided by two sets of continuous-current compound-wound dynamos direct coupled to vertical type steam engines.

LAUNCHES AND TRIAL TRIPS.

BELJEANNE, twin-screw motor vessel; built by Sir W. G. Armstrong, Whitworth and Co., Ltd.: to the order of Rederiet Belpareil A/S., Oslo; dimensions, 427ft. 10in. by 68ft.; 10,000 tons deadweight. Engines, two sets of two-cycle four-cylinder single-acting Armstrong-Sulzer Diesel; constructed by the builders; trial trip, August 27th.

PULPIT POINT, oil tank vessel; built by Lithgows, Ltd., to the order of the Vacuum Oil Company, Ltd.; dimensions, 460ft. by 62ft. 6in. by 36ft. 6in. Engines, inverted, direct-acting, triple-expansion, pressure 220 lb.; constructed by David Rowan and Co., Ltd.; launch, August 27th.

PLUME, oil tank vessel; built by Lithgows, Ltd., of Port-Glasgow, to the order of the Vacuum Oil Company, Ltd.; dimensions, 460ft. by 62ft. 6in. by 36ft. 6in. Engines, inverted, direct-acting, triple-expansion, pressure 220 lb.; constructed by David Rowan and Co., Ltd.; trial trip, August 30th.

IDOMENEUS, twin-screw motor ship; built by Workman, Clark and Co., Ltd.; to the order of Alfred Holt and Co.; dimensions, 459½ft. by 58½ft. by 32½ft.; 8000 gross tonnage. Engines, twin sets of eight-cylinder four-stroke Diesel; constructed by Burmeister and Wain; trial trip, August 31st.

BRITISH GOVERNOR, single-screw steamer: built by Swan, Hunter and Wigham Richardson, Ltd., to the order of the Anglo-Persian Oil Company; dimensions, 454ft. by 57ft. beam; 10,150 tons deadweight. Engines, triple-expansion; constructed by the builders; launch, September 10th.

MEERNOO, cargo steamer; built by Swan, Hunter and Wigham Richardson, Ltd.; to the order of the Melbourne Steamship Company, Ltd.; dimensions, 296ft. by 42½ft. beam; 3000 tons deadweight. Engines, triple-expansion; constructed by Workman, Clark and Co., Ltd.; trial trip, September 16th.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Market Situation.

LITTLE change from last week is apparent in the industrial position in the Midlands and Staffordshire, where the lack of any settlement of the coal trouble is still the chief topic of discussion. There were few transactions in material produced in this district at the Birmingham iron market to-day—Thursday. The plants in operation are working for the most part on contracts which engage all their resources. The hopeful tone of the market is maintained, and a strong undercurrent of business is noticeable. Orders and inquiries are numerous, and the accumulation will insure steady work at the mills and furnaces when the coal strike is over. There is very little change in the price position, and no disposition on the part of makers or buyers to enter into forward engagements. In this respect, the situation is likely to remain until there is a settlement of the coal trade dispute.

Steel Getting Scarce.

Steel business continues on restricted lines. Fair inquiries are being received for constructional material, but native steel is very difficult to obtain, though prices, where they can be given, are on recent levels. Many works are now getting very short of steel and much continental material is being imported for use in connection with large undertakings. The local re-rolling mills have been kept busy for some weeks owing to the number of other mills which have been closed down, and this state of affairs is likely to continue. Indeed, production has increased slightly, owing to the better supplies of coal now available from the Cannock and Warwickshire coalfields. The price is high, however, being something like three times the normal figure. Orders for 500 and 600-ton lots of constructional material are among those received by a Black Country firm this week. Bars are quoted £8 10s. as a minimum, but more is generally required. About the lowest price for gas strip is £8 17s. 6d. No billets of home production are being offered. There is increasing stringency in the chief continental markets. Offerings of steel are on a smaller scale, and prices are moving up. It would seem that continental competitors are using more crude and semi-manufactured material in their own finishing mills to exploit the freer opportunities our troubles give them in neutral markets. Neither Belgium nor France is entertaining more business in billets. German billets, however, are on offer at £6 upwards for 2in. Imported sheet bars are at about £6 6s. Finished steel from the Continent is also dearer. For angles, as much as £6 12s. 6d. is asked by local merchants, while joists are quoted up to £6 7s. 6d.

Staffordshire Bar Iron.

The Staffordshire bar iron industry remains in a comatose condition, and any resuscitation is not to be expected before the mines turn out normal supplies of suitable fuel, and at a price which will permit of profitable production. Ironmasters are for the most part well supplied with orders, on which they are eager to make a start, but they prefer to remain idle rather than run the risk of lowering the standard of their products by utilising inferior fuel. A few Crown bars of Lancashire origin are coming into the district, but as much as £13 per ton is asked for it. Consumers, naturally, where they possibly can, refrain from buying. Nut and bolt makers in this district who have a fair amount of work on hand, are faced with increased production costs. Belgian No. 3 bars, which are now almost the only material used by the nut and bolt makers, have advanced a further half a crown to 5s. per ton, being now quoted £6 5s. to £6 7s. 6d. per ton delivered. Some consumers, however, have large contracts running, and will not be affected by the advance.

Raw Iron.

Foundries in the Birmingham area are kept going with the help of North Country pig iron, but supplies from both Cleveland and Durham are becoming more restricted, and are being supplemented by imported pig, chiefly from the Continent. With the prospect of additional furnaces coming into operation in the immediate future imperilled by the gloomy prospects in the coalfields, producers are stiffening their quotations somewhat. On 'Change in Birmingham to-day—Thursday—Cleveland No. 3 was quoted £4 12s. 6d. at furnaces, making with cost of freight £5 7s. 6d. to the consumer in the Midlands. Derbyshire furnacemen, who recently undertook a certain amount of business for execution after resumption at £4 for No. 3, now want £4 5s., being disinclined to commit themselves more deeply at the lower figure in view of the prolongation of the deadlock, and the impossibility of forecasting future costs. Considerable orders are being placed for Belgian pig iron for shipment next month. Pig iron from the Continent is on offer at £4 13s., and deliveries are said to be coming through satisfactorily within three to four weeks. Many orders are being placed for this material.

Galvanised Sheets.

Galvanised sheet works are fairly occupied, some firms being fully booked to the end of October. Export trade is rather quiet, business with the Far East not having been so good recently, but good quantities have been despatched to Central and South America, India and the Straits. Some fair inquiries for the home market have been received during the last few days, although the autumn seasonal trade has hardly started. Some of the mills which are still running have a certain amount of unallotted capacity in prospect, and they have lowered their quotation for 24 gauge corrugateds to £16 5s., as a means of finding employment for it. In other cases, the £16 10s. quotation is adhered to.

Mining Situation.

The drift back to work in the Midland coalfields continues, and despite all the efforts of the leaders and officials the numbers are growing larger every day. The men are not at all optimistic as to the chances of an early national settlement, and the district settlements under which they are now working are considered by many to be superior to anything the leaders are likely to obtain for them. The real workers amongst them have been too long idle, and their return to the pits has coincided with increased individual output. They seem determined now to do their part towards making the collieries pay. Throughout the Midland area the number of miners at work has increased during the week by several thousands. At the time of writing there were working in the Warwickshire coalfield 11,108, Cannock Chase 10,246, North Staffordshire 8598, Nottinghamshire and Derbyshire 30,663. A considerable tonnage of coal is being raised and a large proportion of it is being consumed by local engineering works, which, with the aid of foreign raw material continue to carry on. This fuel remains dear, but it is preferred to the American or continental supplies, which have in many cases tided the works over till native supplies became available.

Proposed Sugar Beet Factory.

The prospects of a large sugar beet factory being erected in Shropshire is forming a subject of conversation in local circles. Intimation has been received that provided the Shropshire farmers will guarantee by December a minimum beet acreage of 8000, a beet sugar factory will be erected between Shrewsbury and Wellington, at a cost of about £260,000, to be completed by October next year in readiness to take the 1927 crop. It is estimated that it will take ten months to build the factory, and that the contractors will require 300 men to work daily on the factory site during the period of construction. The machinery, &c., will necessitate the employment of over 1600 men for at least six months, and when the factory commences operations 70 skilled artisans will be employed, as well as an equal number of unskilled labourers. In addition, the organised growing of sugar beet will necessitate the employment of over 1000 permanent agricultural workers, as well as a large number of casual labourers. Naturally, no body of intelligent business men would dream of erecting an expensive factory unless they were assured of a supply of raw material. It rests with the farmers to provide the guarantee, both in the interests of the manufacturing company and of the large numbers who will be employed producing the raw material.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

The General Outlook.

THE position in the engineering industries of Lancashire is summed up by the Manchester Chamber of Commerce in the course of a statement on conditions in general. Engineering firms, it is pointed out, are less dependent upon home supplies of coal than those in most other industries, as a larger proportion have electrical power. In the last four months some coal users have turned to oil fuel, and a number of others have obtained imported coal. Nearly all have been handicapped in the home trade, but they have kept a keen look-out for foreign contracts, and have obtained some good ones. One Lancashire company is reported to have secured a contract for 73 broad-gauge locomotives, and another the contract for 20 of the new standard type locomotives for metre-gauge railways, all for the Railway Department of the Government of India. A Lancashire textile machine firm is stated to have received orders for three new mills in China. Colliery engineers, of course, have done little since the mines were closed, and the products of machine-tool makers have met with little demand. Cable makers, however, continue, as a rule, to be well employed at profitable prices.

Non-ferrous Metals.

Tin continues to occupy a prominent position in the non-ferrous metal markets, and at prices currently quoted the metal is very much dearer than in March, when the £300 mark was touched, but only just. This section of the market is extremely sensitive now, and it does not require much either of a bullish or bearish nature to set values moving one way or the other. During the past week the "bulls" have had it practically all their own way, and the quotations responded in a startling manner to the resumption of buying on United States account. The fact of the matter is, of course, that the statistical position at the present time seems to be wholly favourable to continued high prices, although speculative interests may quite easily influence the market in the downward direction when the time appears to be opportune. The home demand for copper is only moderate, and is likely to remain so while the coal stoppage drags on. Prices seem to have an easy tendency, although not much ground has actually been lost. Spelter, also, is in restricted demand. The feeling on this market has been rather better, however, and values are slightly higher. Slightly improved buying of lead imparted a somewhat more cheerful tone to this section, and prices responded to some extent.

Iron.

The dominant feature of the iron market at the present time is the firmness of prices that are being quoted for foundry irons for prompt or early delivery. Compared with a week ago, Scottish No. 3 iron has advanced another half-a-crown a ton, bringing current quotations up to £5 10s. per ton, delivered Manchester or equal distance, and very little of the material to be bought at that. This represents an increase of about 16s. compared with what was being asked on this market at the end of April. Middlesbrough iron, which is also now quoted at about £5 10s per ton, delivered, is 5s. dearer than it was a week ago, and

there is no promise of delivery before the end of next month. East Coast foundry has been offered in small parcels at about £5 7s. 6d. per ton delivered, and hematite might be bought at something like £4 18s. per ton. As regards delivery after the coal stoppage, there seems to be a general abstention on the part of iron producers to commit themselves. Derbyshire makers, certainly, are entirely off the market at their previous quotation of £4 per ton at the furnaces, and it would not be an easy matter to place an order even at £4 5s., which seems to be about the figure round which ideas are hovering for the time being. There is little or no Lancashire bar iron available now.

Steel.

Steel rollers are having no difficulty in disposing of the very limited quantities which some of them are producing, and there is a tendency, so far as prompt business is concerned, for selling prices to firm up a little in sympathy with production costs. For this reason, and primarily because of the higher quotations ruling for imported billets, up to £9 10s. per ton has been asked here this week for re-rolled bars. Basic steel bars are quoted at £8 15s. to £9 for forward delivery, although there seems to be less anxiety to sell in some instances, for one firm which was offering plates at £8 5s. a week ago has within the last day or two refused an order on this basis. After being quoted on this market last week down to £16 per ton f.o.b., for 24-gauge Indian specifications, there has been a firmer tendency, and to-day's value is about £16 5s., without, however, attracting much buying interest from the Indian market, cabled offers from there within the last few days being about 10s. per ton below what is now being quoted here. There has not been much inquiry reported for thin sheets, but prices are firm and unchanged. Continental semi-finished steels are again firmer and very largely nominal, for there is not much to be bought for delivery within a reasonable period. Billets are quoted at £5 12s. 6d., sheet bars at £5 17s. 6d., and wire rods at up to £6 15s., for cash against shipping documents, and including delivery to users' works in this district. On the same basis continental steel bars are quoted at £6 5s., sections at £6 7s. 6d., joists at £6 2s. 6d., Siemens plates at £7 2s. 6d., and ordinary plates at about £6 10s. per ton. Inquiry is still good, but the length of time taken to effect deliveries is undoubtedly a serious obstacle. Some firms, constructional engineers in particular, are being hampered on this account in respect of materials ordered some time ago.

Scrap.

There has been a slight improvement this week in business reported in non-ferrous metal scrap. Braziery copper at £52, clean light copper at £57, lead at £31 10s., zinc at £25 10s., brass rod turnings at £39 to £40, and heavy yellow brass at £45, delivered to users' works, are steady, but cast aluminium at about £80 and selected gun-metal scrap at £53, are slightly easier.

Engineering at Liverpool.

Liverpool's industries, including the engineering branches, are naturally largely overshadowed by the primary industry of the city—that of shipping. An effort is, however, to be made next month—from the 15th to the 30th—to bring the purely industrial side of Liverpool's activities into prominence by means of an exhibition. Besides general engineering, the Liverpool area is interested in shipbuilding, motor and marine engineering, cable making, and telephone manufacturing. These branches will be represented at the exhibition by Cammell Laird and Co., Ltd., the Liverpool Electric Cable Company, Ltd., the Mackintosh Cable Company, Ltd., Callenders Cable and Construction Company, Ltd., Sandon Motor and Engineering Company, Ltd., Allen-Liversedge, Ltd., R. MacIvor and Sons, Ltd., the J. Davies Insulating Company, and the Automatic Telephone Company, Ltd.

BARROW-IN-FURNESS.

The Outlook.

The iron and steel makers are idle with the exception of the hoop works, which are using Belgian billets. There is no iron or steel to sell out of stocks, and the booking of orders for iron and steel to be delivered at a date which the end of the coal dispute will to some extent determine, is the only business being done. This booking of orders for future delivery has been fairly heavy, and there are no works in this district which should be idle during the first twelve months after the restart. The coal strike is affecting certain departments at Vickers' works, for naturally material for shipbuilding, &c., is being held up.

Shipbuilding and Engineering.

The receipt of an important naval contract for a large submarine depôt ship by Vickers Ltd. has been announced at last. In this letter the possible receipt of orders was hinted at a few weeks ago. This order is a large one, and will mean the employment of many hands, but the most important feature about it is the fact that the Admiralty has agreed to internal-combustion engines being installed. The M.A.N. double-acting engine has already made a name for itself, and Vickers have proved their shrewdness in obtaining the patent rights in this country. This is the type of engine which the depôt ship will have, and as there will be large sets for generating power for the machinery which the vessel will carry to deal with repairs, &c., the engineering side of the contract is obviously an important one.

The Backbarrow Scheme.

The Electricity Commissioners have not been long in replying to the inquiry from Barrow, which asked them if they considered the Backbarrow electricity scheme a good one, both from an engineering and financial point of view. They have practically turned it down, explaining that the scheme would not provide all the power required, and that in view of the expenditure which would be involved, there did not appear to be any more margin left than with the scheme of obtaining a certain amount of power from Vickers' power station, which was erected during the war. The Barrow Council has not said its last word yet, and it may press the matter a little further with the Commissioners, but there is a general feeling that there is now no chance of obtaining the desired powers. The unfortunate thing is that there has already been spent a certain amount of money on the furthering of the scheme, and this expenditure may lead to some acrimonious discussions at the next meeting.

SHEFFIELD.

(From our own Correspondent.)

State of the Steel Trades.

THERE is no improvement to report in the condition of the heavy steel trade of Sheffield and district, which continues at a very low ebb owing to the absence of coal supplies. A few furnaces are at work, chiefly on the production of steel required for railway axles, tires, and springs, and there is such a shortage of material generally that one of the largest East End firms is expecting to restart two furnaces at once, in order to cope with urgent orders. The Sheffield Chamber of Commerce *Journal* estimates that the lighter and medium trades have worked at quite half capacity during the present month, thanks to supplies of outcrop coal, gas, electricity, and some foreign coal. During the past week or two several crucible steel plants, which had been idle since the beginning of May, have been restarted with German coke. In this branch several firms are doing rather better, but reports from the majority of firms are opposite in character. At present the file trade is not in a satisfactory condition. The demand has fallen off considerably during this month, owing to the restricted activity in the engineering trades generally, and the absence of Russian orders, and about a third of the operatives are now unemployed or are working short time. There is but a quiet demand for twist drills, while in the case of certain kinds of engineers' small tools and circular saws production is being seriously hindered by inability to obtain malleable castings and the anthracite coal required for the firing of producer gas plants. The report from the rolling mills is that work is gradually shrinking.

Good Prospects.

The feeling of optimism with regard to the future of the steel trades continues, but manufacturers, while seeking work ahead, are not so sanguine on the subject of profits. During the stoppage a good number of large contracts have been booked for shipbuilding and constructional work. These will involve the consumption of large quantities of steel of various kinds, and their execution will also mean a large call for Sheffield tool steel and tools. The proportion of orders captured by foreign competitors during the strike has not been as large as might have been expected. "Another good point," says the Chamber of Commerce *Journal*, "is that, what may be called international prices are tending to become more profitable. Our continental competitors are not only tired of working on small profits, and are advancing prices on that account, but there is a general increase in their costs of production and transport." A less satisfactory feature of the outlook, however, is the probable higher cost of coal after the strike. Some firms have entered into contracts for twelve months on the basis of a shilling per ton advance, and several collieries are asking for higher figures than this, running up to 3s. per ton. In view of the large quantities of coal used in steel processes, these figures are more serious than they look. It is considered that it will be a long time before best South Yorkshire hards can again be bought as low as 16s. and 17s. per ton at the pits, as was possible before the beginning of the present trouble.

The Shipbuilding Outlook.

An important shipbuilding contract has been placed during the week with a Sheffield firm, and, although the vessel will be built on the coast, local industry will no doubt benefit. The order is one placed by the Admiralty with Vickers Ltd. for a large motor submarine depôt ship. The vessel will be 600ft. long, and will be fitted with fully-equipped workshops for carrying out general repairs to submarines. The main propelling machinery will consist of twin-screw double-acting internal-combustion engines, which will be manufactured at Barrow-in-Furness from British materials under licence from the Maschinenfabrik Augsburg-Nürnberg A.G. Engines of this type have never before been made in this country. The construction of the vessel will provide a considerable amount of work extending possibly over two years at the Vickers Ltd. Barrow establishment, and, with other contracts already in hand, will enable the firm to employ from 1500 to 2000 more men. Vickers Ltd. is also tendering for a new British cruiser, three submarines, a large floating dock intended for Singapore, and a big liner for a Swedish firm. Other inquiries are being received, so that prospects for British shipbuilding seem brighter. Another shipping matter of interest to Sheffield is the report, published a few days ago, from Clydebank, that a leading British firm of shipowners is contemplating the building of a liner no less than 1000ft. long. It is stated that inquiries have already been made from the Clyde Navigation Trust for an assurance that such a vessel can be safely launched and taken out to sea. With the report is coupled the name of John Brown and Co., Ltd., of Sheffield and Clydebank. This firm were the builders of the Aquitania, the largest vessel ever built in home yards, which is 868ft. long. On inquiry at Messrs. Brown's Sheffield offices, I was informed that nothing was yet known of the project there.

Points from Reports.

Several company reports of interest have come to hand during the past few days. The Sheffield Forge and Rolling Mills Company, Ltd., has had a loss, during the year ended June, of £5023, bringing the total deficit up to £41,246. The directors state that the result of the year's operations showed a decided improvement until the coal dispute. A fair profit had been made over the first nine months, but all disappeared in the subsequent three months, owing to the coal stoppage. "It only needs a return of industrial peace," they add, "to insure a return to the prosperous days enjoyed by the company prior to the war. It should be borne in mind, however, that industry is still greatly hampered both by Imperial and local taxation." The Sheepbridge Coal and Iron Company, Ltd., reports a profit, for the twelve months ended June, of £68,721, as compared with £112,444 in the previous year. In view of the heavy losses incurred during the current year, owing to the miners' strike, the directors do not consider it advisable to pay any further ordinary dividend—in addition to the interim of 2½ per cent.—but if the strike should terminate within a comparatively short period, they will again consider the matter. They report that the development of Glapwell No. 3 colliery proceeded satisfactorily until the strike began and the new washer has been operated successfully. At the Firbeck Main Colliery the output of coal had rapidly increased prior to the strike, and the expenditure on capital account is practically completed. The Top Hard seam was proved on January 13th last at the Newstead Company's new sinking at Blidworth—to be known as Newstead No. 3 Colliery—the headings are progressing, the erection of the surface plant is approaching completion, and the prospects of this undertaking are promising. The Staveley Coal and Iron Company, Ltd., reports a net profit of £158,588, as compared with £279,135, and the distribution for the year is 5 per cent. as against 7½, tax free in both cases. The year's trading of the New Monckton Collieries, Ltd., resulted in a credit balance of £6835, as against £31,792. No ordinary dividend is recommended. Ibbotson Brothers and Co., Ltd., steel makers, Sheffield, made a profit of £11,321, as compared with £14,052. The dividend is maintained at 7½ per cent., tax free.

Cutlery and Plate.

Conditions in these trades are better than at any previous period of the present year. This improvement has been brought about by a steady flow of orders for the winter season trade. Most of them have been received from abroad, the home demand not showing much increase. There is still great keenness of competition, as a result of which prices are severely cut.

Linking Up Colliery Electrical Supplies.

Excellent progress is reported with the linking up of the various pits of the Doncaster Collieries Association, with a view to insuring a continuous and uninterrupted electrical supply. Part of the scheme has been in operation for some time, and now the last portion of the ring, from Hickleton Main to Yorkshire Main, is in hand. When that is completed, in two or three weeks, not only the two pits named, but also Markham Main, Bullcroft Main, and Brodsworth Main, will be linked together, and will form one of the largest colliery electrical undertakings in the country. At each colliery, electrical energy is produced in excess of its individual requirements, and the surplus goes into the general supply. If, therefore, the current at any colliery should fail, it will be able to fall back on the general supply, and thus continue to carry on. The system, when fully in operation, will furnish an available supply of between 7500 and 8000 kilowatts at any time.

NORTH OF ENGLAND.

(From our own Correspondent.)

Collieries Restarted.

THE restarting of the Plenmeller pits, near Haltwhistle this week, with a very large percentage of the full normal complement of men, makes the outlook in the Northern coalfield a little more cheery. The owners of this enterprise, the Plenmeller Collieries, Ltd., have, unfortunately, passed through troublous times in recent years, and since June, 1925, the company has been in the hands of a receiving manager. The pit, however, continued working until the outbreak of the present trouble, but since then no coal has been drawn. It was recently decided, for financial reasons, to dismantle the pit, and preliminary steps were taken to that end. This decision probably had the effect of bringing matters to a head. The workers, who live in and around Haltwhistle in privately owned property—the company owns no colliery houses—are admittedly loyal trade unionists, but the situation was one calling for immediate action; and after having had the situation from the employers' point of view clearly explained to them, they decided by a large majority to return to work. The position, bluntly put, was that if they did not return to work, there would be no work to return to. In other words, the alternatives were loyalty to the union or duty to their wives and families. The conditions under which operations have been resumed are that the men returned to work on the same terms as they went out—until the dispute is settled, nationally or otherwise. These terms are a seven-hour day and 100 per cent. on the basic wage. The whole of the men, some 300, have returned to work, and production is expected to reach from 400 to 500 tons per day. The coal from the Plenmeller pits includes steam, gas and coking varieties, and it has always been in good demand, mainly for home trade. It is hoped that other pits may get a similar restart, although at the moment there is no definite information to hand.

Big Contracts for Tyneside Engineers.

Two big contracts in the South of England have been secured by Gustavus Bailey, Ltd., of South Shields and Newcastle. One is for a large main sewer scheme for the Walthamstow Urban District Council, which is estimated to cost about £50,000, and the other contract relates to a main drainage scheme for the Rochester City Council, estimated to cost about £40,000. The first-mentioned contract includes a 4ft. sewer, about 1½ miles long, built in brick and cast iron pipes, and which is to cross the river Lea, and will entail a considerable amount of excavation work. The Rochester scheme will be commenced after the settlement of the coal dispute, and will consist of providing a complete new drainage system for

that city. The contract for the 18in. drainage pipes, it is understood, has been placed with Messrs. Woodwards. Messrs. Taylor and Wallin, civil engineers, Newcastle, have been appointed engineers for a water supply scheme in the Wigton area, estimated to cost over £60,000, and they have also been selected as the engineers for a large scheme at Portadown, Ireland.

Cleveland Iron Trade.

The position in the Cleveland pig iron trade is becoming increasingly difficult, owing to the scarcity of supplies. Makers have no longer any of the standard quality to offer for distribution this month, and there is only a very limitied quantity available for October. In the hope that movement towards normal conditions cannot be much longer delayed, consumers have been putting out a fair number of inquiries this week, but makers have shown no disposition to fix up business. While supplies of fuel are ample, consumers of coal and coke have to pay high prices, and the consequent heavy cost of production is harassing manufacturers, who complain that current quotations are altogether unremunerative. Consumers of foundry pig iron are using a large proportion of continental iron, the quality of which is understood to be satisfactory, and the price of which is over 10s. per ton below that of Cleveland. Foreign iron, however, is now much less freely offered in this district than it has been. Continental producers are said to be well sold and inclined to hold out for higher prices. To home consumers, No. 1 Cleveland foundry iron is 96s.; No. 3 G.M.B., 93s. 6d.; No. 4 foundry, 92s. 6d.; and No. 4 forge, 92s.; while for shipment to foreign destinations prices are put at 6d. per ton above these figures.

Hematite Pig Iron.

The hematite pig iron trade has been reduced to even smaller proportions than at any previous period of the coal dispute. There is a small stock of siliceous hematite iron, for which prices range from 85s. to 87s. 6d. per ton, but apart from this there is only the current output of one blast-furnace available, and mixed numbers are offered at a minimum of 83s. per ton.

Ironmaking Materials.

The foreign ore trade is still absolutely idle. Rates are still based on best Rubio ore at 21s. 6d. per ton, c.i.f. Tees, but in the absence of transactions, quotations are purely nominal. Coke quotations keep high.

Manufactured Iron and Steel.

There is no new feature of moment in the manufactured iron and steel trade. Negotiations on forward account fail to result in actual sales, largely owing to the continued uncertainty as to the level at which quotations are likely to settle; but contracts entered into some time ago, the execution of which has necessarily been in abeyance, are understood to be sufficiently heavy to keep producers busy for awhile, when the fuel position warrants the restarting of inoperative plant. Prices are unchanged.

The Coal Market.

The coal market remains idle. Forward business is not talked of in the present circumstances, but high prices are mentioned for the first few weeks after the collieries resume work. There have been, however, steam coals sold over the first quarter of next year up to 17s. 6d. per ton. A good trade could be done if even an approximate date of delivery could be cited. As it is, the foreign consumers who used to buy from this district are making their winter purchases irrespective of what may happen in this country, with its lack of promise of an early settlement of the dispute. Hope is now almost abandoned of getting any Baltic trade before the season ends.

SCOTLAND.

(From our own Correspondent.)

Shipbuilding.

DURING the past week a new shipbuilding company was registered under the Companies Acts, under the name of the Port-Glasgow Shipbuilding Company, Ltd., the share capital of which is £58,680, in shares of £1 each. The new company will carry on the business of builders and repairers of sailing and steam vessels, and a statement has been issued in lieu of prospectus. The list of subscribers include:—John Slater, colliery proprietor, Adelaide House, King William-street, London; W. A. Hayward, merchant, "Leahurst," Eastbourne; H. F. Hayward, merchant, 32, Fenchurch-street, London; and Robert Crawford Wood, shipbuilder, 91, Newark-street, Greenock.

Ship Repairs.

A notable piece of repair work has just been completed by the Grangemouth Dockyard Company in the reconstruction of the Cardiff steamer Porthcawl, which went ashore in the Firth of Forth in February last. The ship's bottom was penetrated by rocks, both fore and aft, and when dry-docked the Porthcawl was found to be practically broken through just forward of the bridge, and also in way of the mainmast, the deck, shell and bottom plates being doubled, buckled or broken through. The double bottom was damaged from end to end. After consideration by Lloyds and the underwriters, it was decided to repair the vessel, and the contract was secured by the Grangemouth Dockyard Company. The damaged shell and deck plates and bottom plating floors were cut out and new frames fitted and all damage made good. The machinery had to be taken adrift and overhauled, the shafting straightened and re-aligned, and the propeller renewed. Delays have been caused by the coal strike, but when the Porthcawl at last left dock she was practically a new vessel.

Steel and Iron.

Another week has come and gone without bringing any change in the situation in the steel and iron trades. The production is confined to a few works making steel bars, steel sheets and light material generally. In some cases it is not possible to secure full outputs, owing to the unsuitability of the foreign coal available. The few works in operation are busy, and sheet makers cannot promise anything in the way of early deliveries. The demand for bar iron is moderate and very firm prices are quoted for available material.

Pig Iron.

The position with regard to pig iron is likewise unchanged. Some brands of foundry are unobtainable, and prices for those still procurable are very firm. Quotations are nominally unchanged, but prices are a matter of arrangement.

Coal.

The quantity of home coal available is still extremely limited, and prices are on a high level. Scottish screened coal is quoted 58s. 6d.; triping, 50s.; and dross, 40s.—all per ton in wagons at the pithead. Household fuel is selling in some districts at 4s. per cwt.

Foreign Coal.

The market for foreign coal has been very active and strong during the past week. Importers have been confining their purchases to quantities against prompt deliveries, owing to the possibility of a sudden collapse of the coal strike. During the past week a greatly increased demand coincided with dwindling supplies, and something in the nature of a famine prevailed for a day or two. Prices advanced considerably, and while demands subsided somewhat at the week-end, a high level of prices was maintained. Silesian screened, 60s. to 60s. 3d.; unscreened, 57s. 6d.; Westphalian screened, 57s. 6d. to 60s.; unscreened, 56s.—all per ton f.o.t. at Glasgow, Grangemouth, Bo'ness or Leith. American unscreened, 57s. 6d. per ton f.o.t. Glasgow; Westphalian foundry coke, 48s. per ton f.o.t. Grangemouth or Bo'ness; Scottish patent fuel, 45s. per ton f.o.b. Glasgow, Grangemouth or Bo'ness, and 46s. at Leith.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Dispute Outlook.

THE efforts of the Government seem fated to be unsuccessful, as all proposals from official quarters for bringing about the termination of the coal stoppage fail to meet with acceptance. From the news to hand at the moment of writing the reply of the Miners' Executive to the latest scheme put forward by the Prime Minister, which provides for the setting up of a National Arbitration Tribunal to revise district settlements, would seem to be a rejection of it. The miners stand for national negotiations and a national agreement. What the attitude of the coalowners is towards the Premier's plan has not been officially disclosed, but there appears to be little doubt that they are just as opposed to the scheme as the Miners' Executive. This is certainly the case so far as individual coalowners are concerned, one of whom in South Wales has declared that the coalowners would not open the mines under the scheme for provisional settlements put forward by Mr. Baldwin. One objection to it, and a very real one from the owners' point of view, is that such a scheme would prevent owners from getting on with business, as they could not enter into contracts for the supply of their coal over a period when the very basis on which they framed their prices when quoting their buyers abroad might undergo serious alteration at the hands of the Arbitration Tribunal. Hopes are now entertained that the Government will stand aside altogether and leave the men themselves to settle the question, as a very strong belief prevails that if this course is adopted, thousands more men will drift back to work and take the best terms offered them. This may not be the case so much in South Wales as in other areas, but there is reason to think that a good number of men in this district would resume. It is stated that one of the largest collieries in South Wales was on the point of restarting work recently as the majority of the men had consented to return, but the intervention of the Chancellor of the Exchequer occurred, and the men held off as they thought that possibly better terms might be obtained by waiting developments. Even Mr. Vernon Hartshorn, who has been more or less silent for some little time, has now come out and informed the secretary of the Miners' Federation that he has talked enough, and urges that it is time that the miners put forward a constructive scheme for the improvement of the industry. The executive of the South Wales Miners' Federation, which met on Saturday last, reviewed the whole position but came to no resolution.

Imported Coals.

There was feverish activity in the chartering of tonnage last week to lift coals for importation to this country. In a week over 140 steamers were taken up to bring coals from the United States, and the rate of freight ran up to round about 28s. 6d., which enables owners to send out their steamers in ballast and make a good profit. As a matter of fact, the rates from Hampton Roads are so good as to cause a dislocation in values for all other markets. Unfortunately, it is the consumer in this country that will have to pay the bill, as the cost of all imports will mount up. The tonnage that was chartered last week was sufficient to load over a million tons of coal for the United Kingdom, but much of it cannot arrive before the end of October and during November. The need is for prompt supplies, and it is feared that the next week or so will see a grave shortage of coals, especially if cold weather should set in. Coals are arriving at South Wales ports on a larger scale, both from the Continent and from America. The number of steamers discharging has varied from twelve to twenty, and it is understood that the Great Western Railway Company and the London, Midland and Scottish Railway Company have cargoes due to arrive in the course of a week or so, aggregating over 100,000 tons. Importers, however, find it practically impossible to arrange for additional prompt cargoes from the Continent for the reason that producers there are full up with orders to the very end of September, and shipment of coals early in October means probably that delivery on this side cannot be obtained before the October 10th to the 15th. There is a certain amount of outcrop coal obtainable, for which as much as 60s. can be secured and 35s. for smalls, while the price for American run-of-the-mine coals is about 54s., and Westphalian large coals from 58s. to 60s., these figures being on wagon.

Forest of Dean.

The miners in the Forest of Dean are returning to work in increasing numbers on the terms of the owners, viz., no reduction in wages for an eight-hour day. It is now reported that practically half the men are back at work, in number about 3000. Last week an average of 100 daily resumed work, and on Tuesday there were a further 200 at the pits.

Iron and Steel Works.

All the steel furnaces at the Dowlais Works, Cardiff, were opened on Monday, and it is understood that they have supplies of American and continental coals sufficient to keep the works going for ten days or a fortnight. Over 1000 employees were taken back after being idle since the general strike in May last. It is also interesting to note that in connection with the contract which Sir William Arrol and Co. Ltd., has secured from the New Zealand Government, valued at £200,000, steel work amounting to 4000 tons is to be fabricated at Swansea at its King's Dock Works. This will provide full time work for some months at the firm's shops at Swansea. A mass meeting of employees of the British Mannesmann Tube Company, Ltd., Landore, Swansea, on Monday, decided to accept certain reductions of wages, which had been put before them for consideration. This company has been effecting economies in various directions, and its request to the men was that they should contribute by wage reductions. These reductions will operate as follows:—Piece workers who earn on a full normal week over £3 5s., a reduction of 17½ per cent. on the difference between £3 5s. and the total wage; no reduction for men earning £3 5s. or less during full normal week; men earning £3 10s., a reduction of 1½ per cent. of total wages or 10½d. The reduction on £4 will be 3·27 per cent. of total wages; on £5 a reduction of 6·1 per cent.; on £6 a reduction of 7·81 per cent.; and on £8 a reduction of 10½ per cent. of total wages.

CATALOGUES.

R. R. BEARD, Ltd., 10, Trafalgar-road, S.E. 15.—Illustrated price list of gas valves, regulators and gauges.

LEYLAND MOTORS, Ltd., Kingston-on-Thames.—Specification and description of the "Trojan" light car.

THE BRITISH INSULATED CABLES, Ltd., Prescot, Lancs.—Publication No. 202, dealing with "Prescot" jointing compounds.

INTERTYPE, Ltd., 15, Britannia-street, W.C. 1.—Brochure illustrating and describing the 1926 pattern "Intertype" machine.

SCOTT BROTHERS (KEIGHLEY), Albion Works, Keighley.—Stock list of new and used machine tools and woodworking machines for sale.

THE NORTON COMPANY, Worcester, Mass, U.S.A.—Several brochures giving particulars of cylindrical and universal grinding machines of various sizes.

PLENTY AND SON, Ltd., Eagle Ironworks, Newbury.—Catalogue of stationary heavy oil engines, giving their specifications and illustrating some typical installations.

THE "BAFFLE PISTON" AND ENGINE COMPANY, Western-road Works, Southall, Middlesex.—Leaflet describing the new "Baffle Piston" for internal combustion engines

THE DRAYTON REGULATOR AND INSTRUMENT COMPANY, Ltd., West Drayton, Middlesex.—Leaflet No. 98, giving particulars of the "Drayton" automatic boiler water level controller.

THE ELECTRICAL EQUIPMENT AND CARBON COMPANY, Ltd., 109, New Oxford-street, W.C. 1.—Booklet describing the new Rosenberg welding generator for which the company is the sole concessionnaire.

CONTRACTS.

THE HEPBURN CONVEYOR COMPANY, Ltd., has secured the contract for Newcastle-under-Lyme Corporation of installing the refuse salvage plant and complete building, with salvage baling equipment.

FAIRFIELD-HOWDEN RUTHS STEAM ACCUMULATORS, Ltd., has just received an order from the Bradford Dyers' Association, Ltd.—Adams Hamilton and Sons, Ltd., Branch, Paisley—for a steam accumulator with a steam storage capacity of 20,000 lb. between the pressures of 165 lb. and 50 lb. per square inch, together with the necessary automatic valves. The size of the accumulator is approximately 47ft. by 13ft.

SPECIFICATIONS FOR BARYTES AND BOILED LINSEED OIL.—The British Engineering Standards Association has just issued British Standard Specifications for barytes and boiled linseed oil. They contain clauses regulating the composition, together with standard reception tests, for the purchase of barytes and boiled linseed oil and appendices giving methods of carrying out the tests. These specifications have been prepared at the request of the paint manufacturers by a committee representative of both the buying and manufacturing interests, and as in the case of all British Standard Specifications, they will be reviewed as experience of their working or progress in the industry renders it necessary, and revised issues will be published from time to time. Copies of these two new Specifications (Nos. 259 and 260–1926) can be obtained from the B.E.S.A. Publications Department, 28, Victoria-street, S.W. 1, price 1s. 2d. each post free.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	18/6 to 21/-
(1) Spanish	18/6 to 21/-
(1) N. African	18/6 to 21/-
N.E. COAST—	
Native	—
Foreign (c.i.f.)	21/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(3) SCOTLAND—		
Hematite	4 2 6	—
No. 1 Foundry	4 15 0	—
No. 3 Foundry	4 10 0	—
N.E. COAST—		
Hematite Mixed Nos.	4 3 0	4 3 0
No. 1	4 3 6	4 3 6
Cleveland—		
No. 1	4 15 0	4 15 6
Silicious Iron	4 15 0	4 15 6
No. 3 G.M.B.	4 12 6	4 13 0
No. 4 Foundry	4 11 6	4 12 0
No. 4 Forge	4 11 0	4 11 6
Mottled	4 10 6	4 11 0
White	4 10 6	4 11 0
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	10 10 0	—
North Staffs. Forge	3 17 6	—
,, ,, Foundry	4 7 6	—
(3) Northampton—		
Foundry No. 3	3 5 0 to 3 10 0	
,, Forge	2 16 0 to 2 17 0	
(3) Derbyshire—	(*None offered.*)	
No. 3 Foundry	3 7 6 to 3 15 0	
Forge	3 2 0 to 3 5 0	
(3) Lincolnshire—	(*None offered.*)	
No. 3 Foundry	3 8 0	—
No. 4 Forge	3 5 6	—
Basic	3 6 0	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 11 0 (*a*) / 4 14 0 (*b*) / 4 17 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	11 10 0 to £12	11 0 0
Best	—	—
N.E. COAST—		
Common Bars	11 5 0	—
LANCS.—		
Crown Bars	11 10 0	—
Second Quality Bars	10 5 0	—
Hoops	14 0 0	—
S. YORKS.—		
Crown Bars	12 10 0	—
Best Bars	13 10 0	—
Hoops	14 10 0	—
MIDLANDS—	(*Prices nominal.*)	
Crown Bars	11 5 0 to 11 10 0	
Marked Bars (Staffs.)	14 0 0	—
Nut and Bolt Bars	10 5 0 to 10 10 0	
Gas Tube Strip	12 10 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	11 0 0	—
Ship Plates, ½in. and up	7 17 6	7 0 0
Sections	7 7 6	6 5 0
Steel Sheets, under 3/16in. to ¼in.	11 5 0 to 12 5 0	
Sheets (Gal. Cor. 24 B.G.)	—	£17 5 0 to £18 5 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 0 0	—
Angles	7 10 0	—
Boiler Plates	11 10 0	—
Joists	7 10 0	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 2 6	—
Soft Billets	7 5 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 0 0†	—
Light Rails	8 5 0 to 8 10 0	
Billets	8 0 0 to 11 10 0†	
MANCHESTER—		
Bars (Round)	9 5 0	—
,, (Small Round)	10 0 0	—
Hoops (Baling)	11 0 0	11 0 0
,, (Soft Steel)	10 15 0	10 15 0
Plates	8 2 6	—
,, (Lancs. Boiler)	11 10 0	—
SHEFFIELD—		
Siemens Acid Billets	10 0 0	—
Bessemer Billets	11 0 0	—
Hard Basic	8 12 6	—
Intermediate Basic	8 2 6	—
Soft Basic	7 5 0	—
Hoops	12 0 0	—
Soft Wire Rods	9 10 0	—
MIDLANDS—		
Small Rolled Bars	7 15 0 to 8 10 0	
Billets and Sheet Bars	6 2 6 to 6 7 6	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	16 5 0 to 16 15 0	
Angles	7 7 6 to 8 17 6	
Joists	7 7 6 to 8 17 6	
Tees	8 7 6 to 9 17 6	
Bridge and Tank Plates	7 17 6 to 8 15 0	
Boiler Plates	11 0 0 to 11 15 0	

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	20/6 to 23/-
Block Tin (cash)	311 10 0
,, (three months)	302 0 0
Copper (cash)	58 15 0
,, (three months)	59 10 0
Spanish Lead (cash)	32 8 9
,, (three months)	31 18 9
Spelter (cash)	34 12 6
,, (three months)	34 11 3
MANCHESTER—	
Copper, Best Selected Ingots	66 2 6
,, Electrolytic	67 0 0
,, Strong Sheets	90 0 0
,, Tubes (Basis Price)	0 1 1
Brass Tubes (Basis Price)	0 1 0
,, Condenser	0 1 2½
Lead, English	32 12 6
,, Foreign	32 5 0
Spelter	34 12 6

FERRO ALLOYS.

(*All prices now nominal.*)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/10 to 1/11 per lb.	
Ferro Tungsten	1/5 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£22 0 0	7/6
,, 6 p.c. to 8 p.c. ,,	£22 0 0	7/3
,, 8 p.c. to 10 p.c. ,,	£20 15 0	6/6
,, Specially Refined		
,, Max. 2 p.c. carbon	£37 0 0	12/6
,, ,, 1 p.c. ,,	£43 10 0	15/-
,, ,, 0·70 p.c. carbon	£54 10 0	17/6
,, ,, carbon free	1/5d. per lb.	
Metallic Chromium	3/- per lb.	
Ferro Manganese (per ton)	£15 for home, £15 for export	
,, Silicon, 45 p.c. to 50 p.c.	£10 0 0 scale 5/- per unit	
,, ,, 75 p.c.	£17 0 0 scale 6/- per unit	
,, Vanadium	14/9 per lb.	
,, Molybdenum	5/3 per lb.	
,, Titanium (carbon free)	0/11 per lb.	
Nickel (per ton)	£170	
Cobalt	10/- per lb.	
Aluminium (per ton)	£112	

FUELS.

SCOTLAND.

	(*Prices nominal.*)	Export.
LANARKSHIRE—		
(f.o.b. Glasgow)—Steam		15/9
,, ,, Ell		16/6
,, ,, Splint		16/6 to 17/-
,, ,, Trebles		15/9
,, ,, Doubles		14/- to 14/6
,, ,, Singles		13/9
AYRSHIRE—		
(f.o.b. Ports)—Steam		16/9
,, ,, Jewel		17/- to 17/6
,, ,, Trebles		17/-
FIFESHIRE—		
(f.o.b. Methil or Burntisland)—Steam		12/6 to 14/9
Screened Navigation		21/-
Trebles		14/- to 15/-
Doubles		14/-
Singles		13/- to 13/6
LOTHIANS		
(f.o.b. Leith)—Best Steam		14/- to 14/3
Secondary Steam		13/6
Trebles		14/6 to 14/9
Doubles		13/6
Singles		13/6

ENGLAND.

(8) N.W. COAST—		
Steams		*No quotation.*
Household		,, ,,
Coke		,, ,,
NORTHUMBERLAND—		
Best Steams		16/-
Second Steams		14/6 to 15/-
Steam Smalls		8/- to 8/6
Unscreened		13/- to 13/6
Household		20/- to 22/-
DURHAM—		
Best Gas		18/6 to 19/-
Second		15/- to 15/6
Household		20/- to 22/-
Foundry Coke		18/- to 20/-
SHEFFIELD	Inland. (*Nominal: none on offer.*)	
Best Hand-picked Branch	31/- to 34/-	—
Barnsley Best Silkstone	28/- to 30/-	—
Derbyshire Best Brights	26/- to 28/-	—
,, ,, House	24/- to 25/-	—
,, ,, Large Nuts	17/- to 20/-	—
,, ,, Small	12/6 to 14/-	—
Yorkshire Hards	17/- to 19/6	—
Derbyshire Hards	16/- to 19/-	—
Rough Slacks	10/- to 12/6	—
Nutty Slacks	7/6 to 9/-	—
Smalls	3/6 to 6/-	—
Blast-furnace Coke (Inland)*	—	—
,, ,, (Export)	f.o.b.	16/- to 17/-

	(9) SOUTH WALES. (*All prices nominal.*)
CARDIFF—	
Steam Coals:	
Best Smokeless Large	26/- to 27/-
Second ,, ,,	24/6 to 25/6
Best Dry Large	24/- to 25/-
Ordinary Dry Large	21/- to 22/-
Best Black Vein Large	25/6 to 26/-
Western Valley Large	24/6 to 25/-
Best Eastern Valley Large	24/- to 25/-
Ordinary ,, ,,	23/6 to 24/-
Best Steam Smalls	17/- to 18/-
Ordinary ,,	16/- to 17/-
Washed Nuts	19/- to 26/-
No. 3 Rhondda Large	26/6 to 27/-
,, ,, Smalls	18/- to 18/6
No. 2 ,, Large	24/- to 25/-
,, ,, Through	20/- to 21/-
,, ,, Smalls	15/- to 16/-
Foundry Coke (export)	40/- to 50/-
Furnace Coke (export)	25/- to 30/-
Patent Fuel	42/6 to 45/-
Pitwood (ex ship)	26/6 to 27/6
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	39/- to 40/-
Seconds	32/6 to 35/-
Red Vein	27/- to 29/-
Machine-made Cobbles	47/6 to 50/-
Nuts	47/6 to 50/-
Beans	42/6 to 44/-
Peas	23/- to 25/-
Breaker Duff	7/6 to 8/-
Rubbly Culm	12/6 to 13/6
Steam Coals:	
Large	22/6 to 24/6
Seconds	20/- to 22/-
Smalls	11/- to 15/-
Cargo Through	16/6 to 17/6

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayreshire.
(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. * For blast-furnaces only, 17/-, with fluctuations according to analysis; open market 17/6 to 19/- at ovens. † Latest quotations available. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

The Trade Outlook.

In the absence of any evidence that the measures being taken by the French Government for the stabilisation of the franc are producing satisfactory results the confidence which has so far been fairly general in an early improvement in the situation is giving way to a more despondent tone. Taxation has been heavily increased and, as a natural corollary, costs have steadily advanced. Prices of raw material are moving up rapidly, and they will continue to increase because the franc is so far from being stabilised by the exceptional measures that it has a tendency to decline still further. The failure of things to turn out as they were expected to do has caused a feeling of discontent, and manufacturers are now preparing for what appears to be an inevitable bad time. Notwithstanding the weakness of the franc, there is very little buying, and there is a general conviction that the iron and steel trades have entered upon a period of inactivity. Manufacturers are looking all round for loopholes of escape from the present unsatisfactory situation. There is a popular belief that collaboration between France and Germany for a general economic reconstruction is taking a tangible form, but so many hopes of a similar character have been ruthlessly destroyed that it is held to be wise to await events.

The Steel Union.

Germany has, at any rate, nearly succeeded in forming the Steel Union, which is regarded as absolutely necessary for the future of the metallurgical trades, although it is not viewed with equal satisfaction by steel consumers, unless the consolidation of the steel industry should have a beneficial effect upon the engineering trades generally. At the meeting held in Paris last week the Belgians were not unanimous in their offer to enter the Cartel on condition of their monthly participation being increased to 290,000 tons, as the Aciéries du Hainaut were still holding out, and the meeting could not come to a definite agreement over the total claimed by Belgium, although the principle of an increased participation was accepted. The Belgians urged that as their last monthly production totalled about 300,000 tons they could not accept the 265,000 tons previously allotted to them. A compromise was suggested and is being considered by the Belgians, and it is hoped that a final agreement will be come to at another meeting to be held at an early date. As a matter of fact, the Belgian steel makers are not particularly anxious to sign the Cartel except in association with British firms. It is understood that the Belgian Government has been making pressing solicitations in Great Britain in the hope of securing British co-operation, and the presence at the meeting of British delegates who had been attending the rail conference in Paris showed that British steel makers are at least closely watching the course of events. It has all along been assumed that as soon as the Steel Cartel is formed it will become international by the adhesion of Great Britain. The Cartel is the first step towards the proposed reorganisation of the whole iron and steel industry. It already includes special steels, and it is intended to absorb all other branches as soon as possible. The tube makers have created a union of their own, and negotiations are now being carried out for the constitution of a union of pig iron producers in France, Germany, Belgium and Luxemburg. The formation of the Steel Union is therefore regarded as the foundation of the general reorganisation of all the metallurgical trades in Europe. It is the only way, it is argued, to lift the industry out of the chaotic situation in which it now finds itself.

Luminous Signals.

The traffic control system in Paris having shown that it is possible to employ luminous signals by day, the same principle is now being extended to the railways. Some official tests were carried out last week with a set of block luminous signals which had been installed by the Westinghouse Company on the recently electrified line between Paris and Reuil. The lamps are set in a large black square panel and are arranged in pairs of white, green, and red lights. They are actuated automatically by the train, and in the event of anything going wrong with the control system the signal comes to danger. The official inspection was made on a perfectly clear day, but nothing has been said as to whether the lights have an advantage over the ordinary signals in foggy weather in day time. It is proposed to continue the trials on one or two suburban electrified lines.

Foreign Trade.

The returns of foreign trade during the first eight months of the year are not unsatisfactory, taking them as a whole, but they reveal a peculiar state of things produced by the efforts to trade with a depreciated currency. The imports amounted to 30,895,586 tons, an increase of 211,338 tons, and were valued at 39,665 million francs, a rise of 13,847 million francs on the corresponding period of 1925. The exports totalled 21,633,083 tons, representing an increase of 1,683,479 tons and a value of 37,510 million francs, which last figure shows an improvement of 9042 million francs. The amount paid for 26,723,635 tons of imported raw material was 27,027 million francs, while the exports of raw material amounted to 17,580,676 tons, the value being 10,573 million francs. The price per ton of raw material imported was thus much above the price per ton of raw material exported. Manufactured goods were exported to the amount of 3,082,164 tons and were valued at 23,890 million francs. These goods were mainly iron and steel, much of which went to England as a result of the miners' strike. The increased value of imported raw material is due to the fact that Germany is no longer required to supply coal on account of reparations and to the necessity, therefore, of paying more for coal because supplies are no longer obtainable from England. This would imply that the efforts to replace British coal have not been altogether satisfactory.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

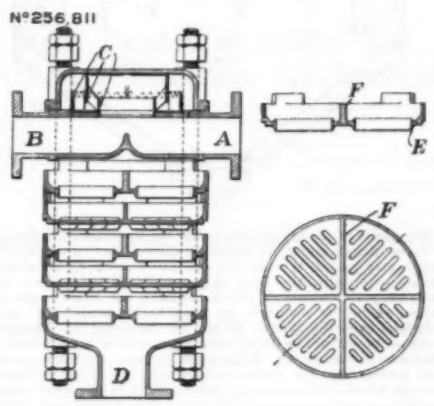
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

CONDENSERS AND FEED-WATER HEATERS.

256,811. September 25th, 1925.—FEED-WATER HEATERS, B. Stephenson, 12, Sheringham-road, Withington, Manchester; and F. Pearn and Co., Ltd., West Gorton, Manchester.

This heater is of the type which is installed inside the steam space of the boiler, so that the feed water is heated by direct contact with the steam and is then conducted to the bottom of the boiler by an internal pipe. The cold feed water is introduced by the two branches A and B and escapes over and under the annular

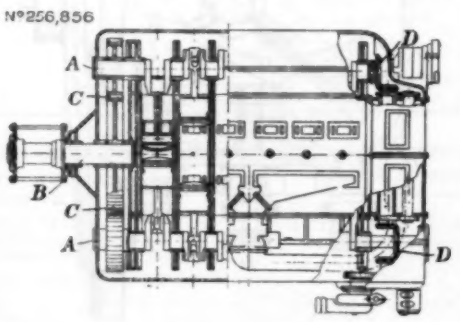


weirs C C C. It then drops down through the heater, which is built up of a series of open-sided trays bolted together. The heated water is collected at the bottom and is taken away from the branch D. A detail view of one of the trays is given and it should be noted that the slots have depending lips E to encourage the water to fall clear, and partitions F to prevent the water gravitating to one side if the heater is tilted during service.—*August 19th*, 1926.

INTERNAL COMBUSTION ENGINES.

256,856. January 19th, 1926.—OPPOSED-PISTON ENGINES, G. Fornaca, 7, Via Giannone, Turin, Italy.

This engine is primarily intended for aeronautical purposes and each cylinder has two outwardly working pistons acting in conjunction with the crank shafts A A. These shafts are geared

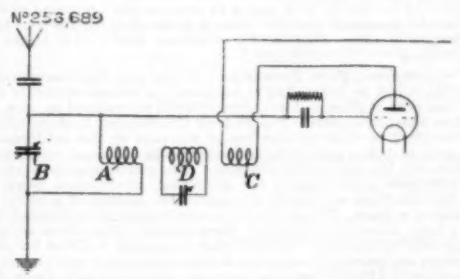


with the propeller shaft B by the gear wheels C C. At the opposite ends of the crank shafts there are mitre gears D D that drive a transverse shaft on which there is mounted a supercharger.—*August 19th*, 1926.

TELEGRAPHS AND TELEPHONES.

256,689. May 12th, 1925.—IMPROVEMENTS IN OR RELATING TO WIRELESS RECEIVING SYSTEMS, Arthur Gerald Benstead and Rotax (Motor Accessories), Ltd., both of Rotax Works, Willesden Junction, London, N.W. 10.

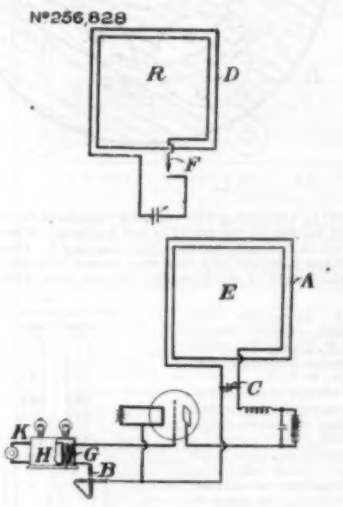
Between the antenna and an earth connection there is a closed



tunable circuit, comprising an inductance coil A and a variable condenser B. The coil of this circuit is inductively coupled to the reaction coil C, one end of which is electrically connected with the anode of the valve and the other end is electrically connected to a positive terminal of an anode battery. Between the coils A and C there is a third coil D, which forms part of a tunable circuit D. By tuning the circuit D to a particular frequency the interaction of the coils A and C at that frequency can be minimised or prevented.—*February 12th*, 1926.

256,828. November 2nd, 1925.—IMPROVEMENTS IN OR RELATING TO WIRELESS TELEGRAPHY AND TELEPHONY, Société Anonyme des Ondes Dirigees, of 46, Rue de la Tour, Paris; and Evenor Brard, of 85bis, Rue du Ranelagh, Paris.

According to this invention, means are provided whereby a primary station—that is, a station having a source of power—may be heard by a secondary station—that is, a station not having a source of power—and may in its turn hear the secondary station so that two-way communication may take place although there is no energy supply at the secondary station. At the primary station an aerial A is fed by generating devices of usual well-known type and comprising a valve with the usual anode battery and inductance, filament heating circuit and associated tuning condenser C and variometer B. At the secondary station R there is an aerial D tuned by means of a condenser. When the station E operates as an emitter and assuming that the stations E



and R are tuned to one another, if the receiving circuit be modulated or manipulated, as by making a break at F, this modulation will be received on the circuit E. If a transformer G with an amplifying device H is placed as shown in the emitting circuit, the signals of the circuit R will be received in the telephone K on the output side of the amplifying device. When the frames A and D are closely tuned to one another on the same wave length the frame A excited by the valve radiates to the frame D in tune therewith, and induces therein an oscillating current of the same frequency as that in the valve. The frame D now becomes a centre of emission of waves, which may be received upon the frame associated with the primary station. It has been found that if modulation is effected or signals are made at the secondary station by means of a key F or microphone or similar means the resulting signals may be received in the telephone K.—*August 19th*, 1926.

TRANSMISSION OF POWER.

246,822. January 13th, 1926.—IMPROVEMENTS IN EXTENSIBLE ELECTRIC CABLES, Land-und-Seekabelwerke Aktiengesellschaft, of Cöln-Nippes, Germany.

If laid cables are stretched or compressed they undergo a deformation of their structure, which in many cases leads to a breakdown of the cable. Stretching or compression of the cable cannot be avoided particularly in places where ground movements take place. In the centre of the conductor of the cable constructed in accordance with this invention there is an insert A of jute or rubber, or a hollow space may be left. In the latter case, which can only be adopted with many layered conductors, a somewhat drawn-out spiral, consisting of copper conductors of hard copper or bronze wire, can be used as the innermost layer. The wire layers B all have the same angle of inclination so as to ensure that all the individual wires in a given layer are of the same length and are therefore equally stressed during stretching or compression. The wires of the individual layers of the conductors are not arranged in direct contact with their neighbours, but a very slight intermediate space C is left for play of the individual wires during stretching or compression. The remainder of the construction of the cable is the usual. The spiral insulation layers move correspondingly with the stretch or compression of the conductor without damage to the insulation of the cable, and the spiral armouring is constrained to follow the conductor extension in the same way, while the material of the lead sheath easily stretches or compresses.—*August 19th*, 1926.

FURNACES.

256,861. January 30th, 1926.—ROTARY ZINC FURNACES, F. E. J. Enke, Wöllmerstrasse 4, Harburg, Elbe, Germany.

In this furnace the zinc blade is introduced at A into the helically ribbed roasting chamber 1 and travels along a helical path in the axial direction of the furnace, that is, perpendicular to the plane of the drawing, to the distant end where it falls through the connecting passages B into the roasting chamber 2 in which the material travels in the opposite circular direction, the pitch of the helical rib or ribs in the chamber 2 being the reverse of that in the chamber 1. At the end of the chamber 2 the material passes through the connecting passage C to the chamber 3. Thence it passes in sequence to the chambers 4, 5, 6, 7, 8, 9, 10, 11, 12, K, L. By the time it reaches the end of chamber L the material is fully roasted. The material in the chambers 1 to 6 has a high sulphur content so that there is generated in these chambers excess heat which is given off to

the adjoining chambers 7 to 12 in which there is no liability to loss of heat and which transmit heat to the chambers K L in the centre of the furnace. The air necessary for the roasting operation is heated in the passages E and is led at F into the

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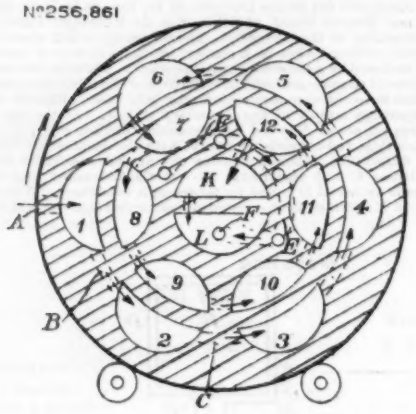

chamber L, traversing the roasting chambers in the direction opposite to that of the travel of the material. The air with the gas given off is finally led from the chamber 1. Presumably the pitch of the helices is such that they do not intersect one another along the length of the furnace.—*August* 19*th*, 1926.

256,444. November 11th, 1925.—COKE OVENS, *O. Y. Imray*, 30, *Southampton-buildings, London, W.C.* 2.

The object of this invention is to render it possible to raise to any height whatever the point of combustion in each heating flue of any coke oven system having vertical flues. This object is attained by building a partition wall between the gas inlet A and air inlet B on the bottom of the heating flue, consisting of superposed movable refractory slabs. These slabs are adapted to slide in grooves in the walls of the heating flues and may be put into position or be added to, removed or exchanged through the top C of the oven battery. Instead of the above-mentioned grooves the slabs may be guided by grooves and tongues. The process of inserting the slabs is described.—*August* 12*th*, 1926.

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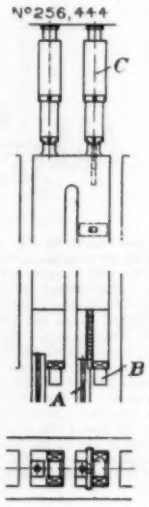

MOTOR CARS AND ROAD TRAFFIC.

256,796. August 27th, 1925.—ENDLESS TRACK VEHICLES, T. A. G. Hawley, Air Ministry, Adastral House, Kingsway, London.

It is suggested in this specification that the normal track of a "caterpillar" vehicle may not, on some occasions, provide sufficient adhesion with the ground. The inventor consequently proposes the superposition of a rubber and fabric band A pro-

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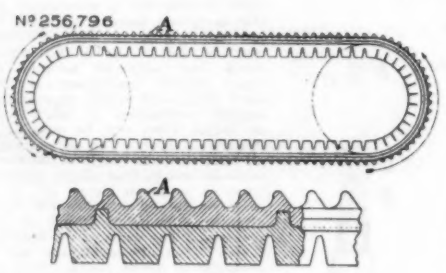

vided with a "bearing surface in the form of rounded saw teeth, with an opposite surface which is adapted to fit, or is complementary to the normal ground bearing surface of a portable track permanently-mounted on the vehicle." It is suggested that the emergency tread may be formed as an endless band or have one or more joints in its length, but no suggestion is made as to how it can be put in place.—*August* 19*th*, 1926.

MISCELLANEOUS.

246,790. September 4th, 1925.—IMPROVEMENT IN ELECTRIC INSULATION, Felten and Guilleaume Carlswerk Actien-Gesellschaft, of Köln-Mülheim, Germany.

This invention relates to a method of manufacturing insulating bodies for high-tension cables, junction boxes, joints, &c., which comprise several layers of paper, the dielectric constant of which is gradated for the well-known purpose of reducing the part voltages in the layers of higher dielectric constant in non-homogeneous electric fields. The impregnated paper insulation of high-tension cables and of their junction boxes and end joints constitutes a particularly important field of application of the invention. Insulating layers of paper of different degrees of dielectric constant are laid upon one another in such a manner that the gradation of the dielectric constant is attained by a corresponding gradation of the specific weight of the insulating paper. The insulation of high-tension cables, junction boxes, and end joints is effected in such a manner that the dielectric constant of the insulating paper is increased by increasing the specific weight by rolling under pressure or by other pressure means, the layers of paper of highest dielectric constant being in direct contact with or in closest proximity to the conductor carrying the current, whilst the outer layers of paper have a gradually diminishing dielectric constant.—*August* 19*th*, 1926.

252,011. May 7th, 1926.—IMPROVEMENTS IN OR RELATING TO MERCURY VAPOUR ARC RECTIFIERS, *International General Electric Company, Incorporated, of* 120, *Broadway, New York.*

The working of rectifiers, more particularly of those with a large output, is frequently jeopardised by the so-called back-firing, which is due, among other causes, to the presence of steam in the rectifier vessel. This invention utilises the principle of absorbing the steam by means of a hygroscopic substance introduced into the envelope of the rectifier. The hygroscopic substance is placed in a removable open tank or similar container, arranged in a space which is in communication with the vacuum in the rectifier. The accompanying drawing shows diagrammatically a mercury rectifier of large size with a suitable

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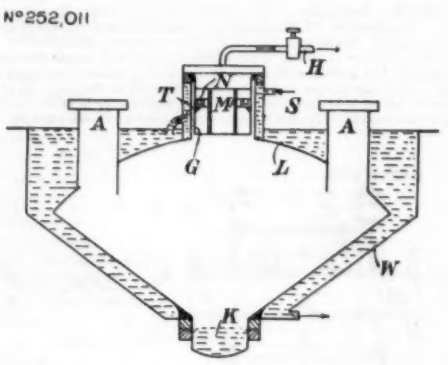

arrangement of the vessel containing the hygroscopic substance. K is the cathode and A the anodes of the rectifier, which is cooled by a water jacket W. In the central branch S to which a suction pipe with the cock H is connected there is an easily interchangeable vessel G which contains the hygroscopic substance, such, for instance, as phosphorus pentoxide, and is protected from the heat of the arc by the screen L. The vessel is placed on a rim T with an annuler insertion N, in which the substance is contained. In order to prevent mercury particles from getting into the insertion a highly porous clay cylinder M through which the steam can easily diffuse is provided between the bottom and the cover of the vessel G.—*August* 19*th*, 1926.

256,795. August 26th, 1925.—LUBRICATORS, R. A. Lister and Co., Ltd., and A. F. Sanders, Dursley, Glos.

This lubricator is put forward as one in which the supplies to a number of different points can be adjusted to a nicety and yet it is inexpensive. The oil is supplied to the lubricator by the pipe A and its level is determined by the overflow pipe B. Running along the length of the apparatus there is a shaft C, which is rocked periodically by the engagement of the crank pin

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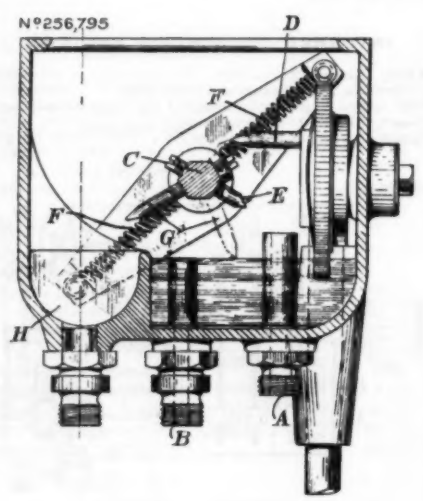

D with the pick E. After engagement the springs F F quickly return the shaft to its original position, and in doing so sweep the dipper G through the oil, so that some of it is splashed into the feed chamber H. There is a chamber H for each point to be lubricated and the amount of oil fed into each chamber is governed by the extent to which the individual dippers reach below the surface of the oil in the main container.—*August* 19*th*, 1926.

CORRECTION.—In the article on page 315 of our last issue, in which we described the 200-ton floating crane built by Werf Gusto Firma A.F. Smulders, of Schiedam, Holland, for the port of Le Havre, it is stated in error at the beginning of the second paragraph that the crane is designed to lift 200 tons to a height of 16ft. This should, of course, read "to a height of 160ft. above the water line."

ARGENTINE PORT FACILITIES.—It has now been ascertained that it will be impossible to complete the reconstruction of the new port of Buenos Aires, even if work be resumed at once, in less than two years. The Federal Government is therefore to be urged to make greater use of the port of Mar-del-Plata in order to deflect part of the congested traffic at present converging towards the port of Buenos Aires. The recent appropriation of 4,000,000 pesos (paper) for additional construction work at Mar-del-Plata will enable a considerable amount of work to be taken in hand. There will be money enough, it is thought, for a large amount of dredging plant, several grain elevators and general equipment. Provided that reasonable facilities for payment are granted, a substantial share of the contracts should be secured by British manufacturers in competition with American, German and Dutch firms, whose representatives, already on the spot, are awaiting the issue of the contract details. It is practically certain that the firm offering the greatest financial facilities will meet with the most favourable consideration. Cash payments for either material or construction must not be expected. Payments will probably be offered in the form of a series of national gold bonds.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INSTITUTION OF FUEL ECONOMY ENGINEERS.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Lecture, "Liquid Fuels," by Dr. A. E. Dunstan. 6 p.m.

TO-DAY TO MONDAY, SEPTEMBER 24TH TO 27TH.

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX.—Balliol College, Oxford. Third conference.

SATURDAY, SEPTEMBER 25TH.

INSTITUTE OF BRITISH FOUNDRYMEN: NEWCASTLE AND DISTRICT BRANCH.—Neville Hall, Newcastle-upon-Tyne. Presidential address by Mr. E. Wood. 6.15 p.m.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS.—Neville Hall, Newcastle-upon-Tyne. Associates' and Students' Section meeting. Paper, "The Chemical Relations of the Principal Varieties of Coal," by Professor George Hickling. 3 p.m.

WEDNESDAY, SEPTEMBER 29TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Chamber of Commerce, New-street, Birmingham. Birmingham Graduates' business meeting. 7.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS: NORTH-WESTERN BRANCH.—Visit to the new works of Henry Simon, Ltd., Cheadle Heath. Meet at Engineers' Club, Manchester. 2 p.m.

THURSDAY, SEPTEMBER 30TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Watergate House, Adelphi, London, W.C. 2. Business meeting of London graduates. 7.30 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS.—The Engineers' Club, Coventry-street, London, W. 1. Presidential address by Sir Seymour B. Tritton. 7.15 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—East Midland District meeting at Gainsborough. 11 a.m.

FRIDAY, OCTOBER 1ST.

FARADAY SOCIETY.—Chemical Society's Rooms, Burlington House, Piccadilly, London, W. 1. Discussion on "Physical Phenomena at Interfaces, with Special Reference to Molecular Orientation." 2.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, Westminster, London, S.W. 1. Paper, "Notes on Transformer Testing and Test Plant," by Mr. L. Smith. 7.30 p.m.

SATURDAY, OCTOBER 2ND.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—Houldsworth Hall, 90, Deansgate, Manchester. Presidential address, "Notes on Foundry Practice," by Mr. S. G. Smith. 4 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—South Midland District meeting at Letchworth. 11 a.m.

MONDAY, OCTOBER 4TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—The College, Loughborough. Loughborough Graduates' business meeting. 7 p.m.

TUESDAY, OCTOBER 5TH.

ENGINEERING GOLFING SOCIETY.—R.A.C. Country Club, Woodcote Park, near Epsom, Surrey. Autumn meeting. 10 a.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Royal Automobile Club, Pall Mall, London, S.W. 1. Presidential address, "The Debt of the Country to the Automobile," by Mr. H. Kerr Thomas. 8 p.m.

WEDNESDAY, OCTOBER 6TH.

INSTITUTION OF AUTOMOBILE ENGINEERS: WESTERN CENTRE.—Merchant Venturers' Technical College, Bristol. Presidential address, "The Debt of the Country to the Automobile," by Mr. H. Kerr Thomas. 6.45 p.m.

INSTITUTION OF SANITARY ENGINEERS.—Caxton Hall, Westminster, London, S.W. 1. Reception and conversazione. Paper, "Housing Problems, with Special Reference to Subsidies and Rural Needs," by Mr. G. B. Chilvers. 6.30 p.m.

TUESDAY, OCTOBER 19TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH: BURNLEY SECTION.—Municipal College, Ormerod-road, Burnley. Paper, "Elementary Science for Practical Moulders," by Mr. A. Jackson. 7.15 p.m.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

WE are advised that, owing to the Westminster Council having decided to re-number a portion of Charing Cross-road, Metro-Vick House will in future be No. 155, Charing Cross-road, not 145, as formerly.

SHEFFIELD STEEL PRODUCTS, Ltd., have removed their London office and showrooms to Stevenage House, 40-44, Holborn Viaduct, London, E.C. 1. Telephone number, 2280 Holborn; telegrams, "Stelprod Cent."

LEYLAND MOTORS, Ltd., make the announcement that they have now established a depôt at Dunbar-street, Belfast. Messrs. Alister Kirk and Co., Ballarat-street, Belfast, are the company's sole selling and service agents for Belfast.

THE WELLMAN SMITH OWEN ENGINEERING CORPORATION, Ltd., Wellman Seaver Rolling Mill Company, Ltd., and the Wellman Bibby Company, Ltd., wish to announce that they have removed their head offices to Victoria Station House, Victoria-street, London, S.W. 1.

BRITISH SEPARATORS, Ltd., has transferred to new offices—Broadway-court, Westminster, London, S.W. 1. Temporary telephone number, Victoria 0625; telegraphic address, "Vickcen, Sowest, London"; and the registered office of this company has been transferred to Buckingham Works, York. Telephone number, York 2310; telegraphic address, "Coordinate, York."